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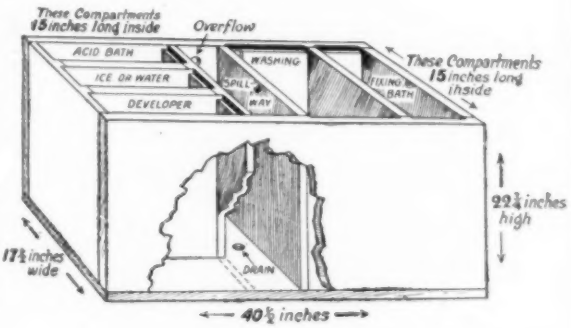

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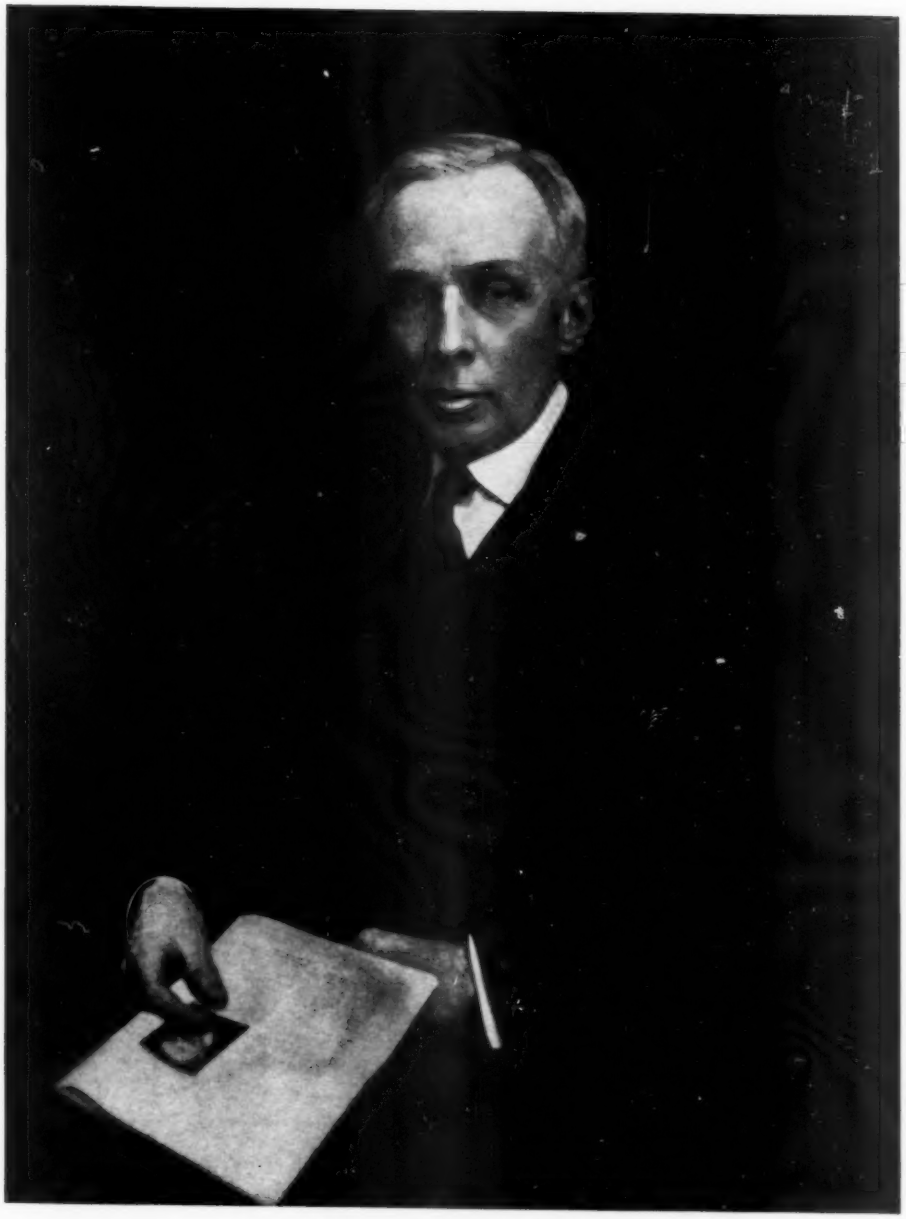

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THE AMERICAN JOURNAL OF ROENTGENOLOGY AND RADIUM THERAPY

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SOME ASPECTS OF THE CANCER PROBLEM*

BY ROBERT KNOX, M.D., M.I.E.E.

LONDON, ENGLAND

MOST important work has been done in cancer therapy since the fact was recognized that with penetrating radiations of roentgen rays and radium rays it was possible to reach practically any depth of tissue.

Attention has been riveted upon the means to be adopted in order to reach this end, and much valuable physical investigation and mechanical ingenuity have been expended for the furtherance of this desirable object. The so-called "lethal dose" has been worked out with a precision that must command our admiration; not only has the lethal dose for cancer been determined, but also that for sarcoma and tubercle, and it has even been determined for most of the normal tissues. There would, therefore, appear to be little more to do than to administer the particular dose for any of these tissues and await the result. The cure of cancer would be within our reach if the claims put forward contained even a modicum of truth. How far we are from so desirable a consummation it will be my endeavor to show in the course of this paper.

One of the master minds in radiology, in a paper communicated at Los Angeles last September, put his finger on the crux of the problem when he stated: "It is not we, but the particular form of tumor which determines whether or not our treatment will be successful." I refer to Professor Guido Holtzknecht, who communicated a paper on "A Review of the Present Status of Deep Roentgen Therapy."

I would go a step further and say it is not even the particular tumor which controls the effect, but its condition, or stage of progress at the moment it receives the appropriate dose of radiations, which will determine the response. There may be a period in the life of a tumor at which it is susceptible to the rays, and that period may be of extremely short duration. If attacked during its responsive state, it may react favorably.

In addition to the condition of the tumor it is also necessary to consider the response of the surrounding tissues; if these are capable of a good reactive response, the chance of effecting an improvement in the condition is greater. The blood is a factor which must also be reckoned with; normal blood is a better medium than that which is impoverished. Nearly all the cases which have yielded to treatment showed a good normal or plus normal blood count.

THE LIFE CYCLE OF A TUMOR

The life history of a tumor is interesting from any point of view, but from none more than the radiological. The majority of tumors we are called upon to treat, are, from the point of view of biological response, beyond our reach. It is useless to irradiate a tumor which is already undergoing extensive though slow necrosis from interference with its blood supply, or one

* Read at the Twenty-fourth Annual Meeting of THE AMERICAN ROENTGEN RAY SOCIETY, Chicago, Ill., Sept. 18–21, 1923.

where an extensive degree of fibrosis has already taken place, for that which we would seek to achieve by treatment has already been done by the tumor and the surrounding tissues. Mr. W. Sampson Handley, whose book on "Cancer of the Breast and its Treatment" teams with practical points of great significance and value, draws attention to what he calls "an unrecognized law in cancerous growths." He states that: "Every aggregation of cancerous cells has a definite life cycle, and after increasing in size for a varying period and at a varying rate, tends spontaneously to undergo degenerative and fibrotic changes. These changes extend from the center of the mass centrifugally to its periphery, lead to its shrinkage, and terminate in the replacement of the aggregation of cancer cells by a fibrous scar. In other words, the natural history of a cancer is one of centrifugal growth followed by centrifugal death.

"To avoid misconception it will be well to state at the outset that the natural cure in cancer is a local, and not a constitutional, process, and that as a rule it closely follows up, without overtaking the centrifugal spread of the permeation, and so fails to arrest the march of the disease. It is certain that in some cases its vigor is sufficient to strangle the growth in an early stage, or to reduce it to impotence for a long period of years; but as a rule, the natural processes of cure go on contemporaneously with the active advance of the disease in other parts of the body farther removed from the primary focus."

Handley gives in full detail the life cycle of a tumor, its method of spread, and, in a number of diagrams, furnishes most illuminating details of the progress of growth. Space allows only a brief reference to his work.

To appreciate fully the difficulties of the practical application of radiations in the treatment and cure of malignant disease, it is necessary to consider more than the life cycle of the tumor. The life cycle of the surrounding normal cells as well as the malignant, must also be studied with care, for it is upon an intelligent appreciation of the life duration of the cells, their intricate construction and physiological processes that success in therapy may depend.

BIOLOGICAL RESPONSE AS A GUIDE TO DOSAGE

Biological response must become one of the factors of dosage, and it is very clear that it will always be the determining factor. All our efforts should be concentrated upon a study of this most important factor. If a fraction of the time spent upon the physical measurements had been devoted to the biological processes, important points might have been worked out. New methods and experimental technique must be devised for ascertaining these points. Systematic blood counts on a large number of cases would yield valuable information, while an estimation of the coagulation coefficient proves another valuable aid to the study. By systematic examination is meant that a number of patients who have had a measured dose should be kept under constant observation, counts being taken at regular and short intervals over a long period of time. High-power magnification of the blood constituents, particularly the nuclear changes, would also be helpful. A clear appreciation of the function of the nucleus and the changes induced in it by radiation and other forms of stimulation might give the clue to the biological response of cellular structures.

Dr. Drew of the Imperial Cancer Research Fund has published several papers lately which give us a very clear indication of the lines upon which the biological response should be investigated. He has shown that tumor strains and normal tissues can be cultivated in vitro. A study of a few examples of his work will help us to understand the processes of growth and the effects upon the normal tissues of the introduction of a tumor strain. An ingenious method of separating a particular type of cell gives a striking example of the effect of radiations upon cell growth. It consists of placing on a slide the particular culture containing the cells to be isolated, covering the area containing the cells with a globule of mercury, and exposing the slide to ultraviolet radiation. All the cells except those under the globule are killed. The mercury is then removed and the cells placed in a

culture medium. Any form of cell appears to be killed if the radiation is sufficiently prolonged in its action. Dr. Drew describes several methods for obtaining pure cultures of tissues and tumors:

1. *Mechanical Separation.* This process was originated by Carrel.

2. *Separation by Ultraviolet Light.* This may be described as probably the best method of separation for cultures in the saline medium, as after a few failures pure cultures can be readily obtained. A series of cultures of the selected tissue, for example, kidney, are examined daily till vigorous growth takes place. In one or more of any series of cultures pure kidney cells will be found growing free from connective tissue elements in certain portions of the growth. A minute globule of mercury is then carefully pushed onto the preparation and so arranged as to cover the selected cells. Provided the globule is not too large, it will be found to remain in position fairly well. The slide is then removed from the microscope and placed under a mercury-vapor lamp, care being taken that it does not become heated. After an exposure of from five to ten minutes it is removed, fresh culture medium added, and the slide returned to the incubator. On examination it will be found that the cells unshielded by the mercury have been killed, and growth, which is pure in character, is taking place from the small fragment shielded. With care the same technique may be applied to plasma culture, but here it frequently fails. It is best to grow the cultures intended for this separation on quartz cover-glasses.

This work by Drew is full of points of great interest to the radiologist, and if the results attained by him can be repeated by a number of workers, a useful aid to the study of biological reaction will be available. It should be possible to study the natural processes of repair by Drew's methods, and side by side with the study, a series of experiments with radiations of different wave-lengths and intensities could be carried on.

TUMOR RESPONSE TO RADIATION

From the nature of tumors, their condition when exposed to radiation, and the uncertainty of their biological action, it is apparent that only a small percentage is likely to respond favorably to treatment. This is what actually happens in practice; a small percentage of striking results occur in everyone's experience. It is from a careful analysis of all the factors at work in these favorable cases that we should be able to arrive at a correct estimation of the probability of effecting a cure in cases suitable for the treatment.

The environment of a tumor, as well as its structure, may also be a favorable factor. Tumors situated in certain regions of the body appear to be, as a class, more readily influenced than those in other regions.

EXPERIMENTAL PRODUCTION OF CANCER

It may be profitable to turn aside, for a moment, from the main thesis of the paper to consider briefly the work that has been done in the experimental production of cancer and other forms of new growth.

Roentgen-ray cancer is too well known to require much description; it is or has been common in early roentgen ray workers, yet it is apparently very difficult to produce experimentally in animals. Malignant growths are readily produced by chronic irritants, such as coal tar, arsenic, etc. Most valuable work has been published in recent years on this profitable field of research. The works of Fibiger, Murray, Leitch, Kennaway and others should be studied very carefully in this relationship; much valuable information will be obtained, which throws light upon the problems upon which we are engaged.

My colleague at the Cancer Hospital, Dr. Archibald Leitch, has shown experimentally on animals that if after a certain stage of irritation of the skin has been induced, the application of the irritant is suspended, the growth goes on to the formation of papilloma and cancer. Leitch summarizes the results of his experiments as follows:

"These experiments show clearly that when tar has been applied repeatedly for a certain length of time, and the irritant is then removed, tumors, even carcinomata, may make their appearance at a later date. It must be that the irritation

produces in the normal cells subjected to its influence, some profound change undetectable by the microscope, so that the cells eventually proliferate in an unrestrained and in a harmful fashion. We may conclude that the neoplastic response to an irritant is a slow tissue reaction that exhibits no defensive property, that subserves no useful function. The internal changes in the cells in the earliest stages may some day be analyzed—at present they are unknown."

Murray makes an important observation when he states that animals which have been previously tarred, and had responded with cancer formation, failed to respond after a second series of tar application. The observation of Leitch is supported in clinical practice by the fact that if, after a long series of treatments have been given, the treatment is stopped, the action may continue for some time; in several cases it was many months.

A number of patients with fibromyoma, who apparently did not receive any benefit from treatment, reported several months after cessation of treatment that the results aimed at had been attained. One case of atrophic cancer of the breast was treated intermittently for about eighteen months with no appreciable change. Treatment was suspended. Four months later the tumor had disappeared except for a small nodule in the upper angle of the right side of the growth. At a later date there was a recurrence of the growth.

The action may be of the same nature as that described by Leitch: biological processes initiated by the irritant in the case of the animal experiments find an analogous action in the example of growth treated by radiations, in that biological processes set going by the radiations appear to go on after the cessation of treatment. If the true interval can be gauged, and a series of doses given at appropriate intervals, the action may be carried on over a long period of time.

Working on a theory of this kind, we have, at the Cancer Hospital and King's College Hospital, been administering doses of considerable magnitude at intervals over long periods, with relatively satisfactory results.

The publication of the work by Seitz and Wintz and others, and the advocacy of the lethal dose with its attendant consequences resulted in a reconsideration of our position, particularly in regard to cancer.

THE LETHAL AND THE STIMULATING DOSE

Seitz and Wintz, in their work on the "Treatment of Cancer and other Tumors," estimated the lethal dose for each form of tumor, and stated that a dose short of the lethal one, say 40 per cent of the estimated lethal dose, is a "stimulating" one, and we are told that if such doses were administered, the tumor would grow as a consequence of having been so stimulated. It is true that since living tissues are concerned, growth must go on; it may vary in its rapidity, and finally become stationary, or it may progress slowly and finally become retrogressive. When a tumor is actively growing, it must be a difficult matter to say when it is actually stimulated by radiations. What appears to be a stimulating effect may after all be only an acceleration of growth quite independent of any extraneous stimulation. It is certainly proved beyond any doubt that a number of cases have been cured or kept from showing increase by the use of the small doses administered at frequent intervals; these, if estimated by modern standards, would undoubtedly come under the heading of stimulating doses. What explanation can be given of this apparent contradiction?

A term "summation of dosage" might be used to explain the action. If a daily fractional dose be given for several days, and all doses are equal, then in so many days a full dose will have been reached. In several weeks' time a good many lethal doses will have been administered. At one period of the treatment the tumor may show signs of retardation. It has been in some way induced to change its activity. The change may be caused in one of two ways: (1) a direct effect upon the tumor cells, with devitalization of these, and subsequent death. If a very large number of cells receive this dose simultaneously when they are in a similar stage of activity, the result will be the same in all, namely, a local death of a large mass of cells. The

normal tissues, the lymph channels, and the phagocytes of the blood stream will carry away the debris, and so the tumor recedes in size. (2) Stimulation of the defensive forces may also induce a similar change in the tumor. It is probable that both are in action at the same time. Apparently a stimulating dose may act upon tumor cells and normal cells to a degree which is determined by the resistance of the constituent cells, and the intensity and duration of the exposure. The term "summation of dosage" might be applied to the sum of the small frequent doses.

SUMMATION OF STIMULI

If a muscle bundle or other tissue is stimulated electrically it responds vigorously for a time; this is followed by a period of fatigue, and if over-stimulated, the muscle may be exhausted and die. Is it not possible that by the use of frequent small doses of radiations the law of summation of stimuli comes into force? The cells are over-stimulated, and either die or become more vulnerable to the natural processes of repair in the tissues, and are overcome. The balance between the normal and abnormal tissues must always be an uncertain one, depending upon a number of variants too numerous to discuss in detail; yet in almost every case of new growth at some period of its history the normal tissue possesses the power of overcoming the invading organisms.

PRACTICAL APPLICATION OF RADIATIONS IN THE TREATMENT OF CANCER

In relation to cancer it is apparent that, though the local and obvious manifestations of the disease can be removed by either operative or radiotherapeutic measures, in the majority of cases something further must be done before a claim can be made in favor of a cure. Even when a wide dissection has been made, of the primary growth and all possible lymphatic extension, recurrence at a later date is almost invariable. Surgery has obviously reached its limits so far as technique is concerned, and most elaborate dissections are now made. As a result it is probable that a longer period of relief is now obtained between the operation and the recurrence.

COMBINED SURGICAL AND RADIOTHERAPEUTIC TREATMENT

Radiotherapeutic treatment is advocated in all cases operated upon for cancer, and time will show the measure of success following such treatment. It might be profitable in this connection briefly to consider what is the aim of such therapeutic measures. Let us take the example of a carcinoma of the breast, and outline the procedure to be followed, and its probable effect upon the growth. Sir Lenthal Cheatle has described the earliest manifestation of carcinoma as occurring in what he calls the proemial breast, a condition which is a prelude to later developments of papillomata and of duct and acinous carcinomata. This type of breast can be recognized clinically by the presence of cysts, and, in its earlier stages, by the irregularity in the size of a duct or ducts. In Sir Lenthal Cheatle's opinion the condition is carcinomatous, although the epitheloid cells remain within the walls of the duct. Cheatle describes five forms of duct irregularity and states that all are now being diagnosed as chronic mastitis.

It is evident that where so much doubt exists in the minds of pathologists and surgeons regarding the exact description of changes in duct epithelium, there cannot be any radical difference from the normal in the type of the cell, nor in its power of response to stimuli, while the absorption equivalent of the two types of cell will frequently be equal.

The administration of the lethal dose to a few isolated and perhaps newly formed cancer cells must be a matter of great difficulty, if we recognize at all the need for such a discrimination. There can be no specific difference in selection of wavelength in cells possessing the same biological properties and reactions. To kill the cancer cell it would also be necessary to kill the adjoining noncancerous cells, and it would require a very specific and discriminating radiation to distinguish between these types.

Assuming that chronic mastitis is a prelude to cancer, is it not a fact that radiations applied to such conditions often yield most excellent results? In almost all the

cases treated the dose is a stimulating one, no attempt being made to give the lethal dose. A technique in which small doses at frequent intervals are given, is frequently successful. If the mastitis is deeply seated, the shorter wave-length must be used, in order to reach the morbid condition and give it a dose in a reasonable time. If such an early condition can be treated, and it is admitted that such are treated, it must follow that in a certain percentage of cases carcinomatous cells are already present when the treatment is given, and it is logical to assume that in such cases a percentage are temporarily arrested by the treatment. The same argument applies to surgery, with the important difference that upon subsequent examination of serial sections of the growth, the presence of carcinomatous cells is proved. This evidence is obtained in a considerable proportion of the cases of mastitis operated upon.

When a surgeon finds evidence of carcinoma, he performs an extensive operation, removing all the lymphatics in the vicinity. The attempt must be made by the radiologist, in all cases subjected to treatment, to emulate the surgeon, and by radiations to lessen the likelihood of a recurrence in the lymphatic chain. If the lethal dose is necessary, this means an enormous dose of radiations applied over areas to include the whole of the breast, the axillary, supraclavicular and mediastinal glands, and an area well below the breast to include the liver and abdominal lymphatics. To achieve this in an early case at one time would be practically impossible on account of the great damage done to the blood constituents. Here again the question of stimulation versus lethal effect has to be considered. Any treatment given must essentially be of the stimulation type, nor from a consideration of the pathological aspects of such conditions would it appear to be possible to administer the lethal dose without locally producing disastrous effects upon the healthy tissues. All that is required is a gentle stimulation of the normal tissues sufficient to induce a slow fibrosis of the lymphatics, and the tissues around them, so that the cancer cell will be included in the fibrous tissue and slowly rendered innocuous.

In the execution of the technique it may be necessary to graduate the penetration in order to achieve these results quickly, the longer wave-lengths being employed for the more superficial structures, the shorter for the more deeply situated; in other words, a progressive selection of wave-lengths may be required for the successful treatment of cancer of the breast. To achieve this end it will be necessary to be thoroughly conversant with the various wave-lengths, and the absorption equivalents before the treatment can be successfully carried out. It is in this connection that we should be grateful to those physicists and technicians who have so greatly helped us in the evolution of a technique possessing such elasticity in execution.

THE SELECTION OF THE WAVE-LENGTH IN THERAPY

The question of wave-length is therefore an important one. Why do we use the short wave-length in therapy? Largely because of the fact that by the use of the penetrating radiation a larger percentage of the beam reaches the deeper structures. We know that superficial cancers of a type similar to those more deeply situated can be removed by long wave-length radiations, and Drew's experiments show that a cancer cell can be killed by the ultraviolet radiation, while Russ has shown that in equal absorption doses the longer wave-length radiation is more effective.

From Russ's experimental results on animals it would appear that for the same quantity of hard and soft rays absorbed, the effect of the softer radiation is greater, and this observation is borne out by experience in the treatment of the human subject. It is not at all established, for example, that the hardest possible roentgen ray, produced at enormous trouble and expense, is essentially the best for the treatment of carcinoma. The radiation which is absorbed by the tissue is the active agent in the production of therapeutic effects. It is probable that with the very penetrating radiation the larger percentage goes beyond the tumor and exercises practically no action upon it. This is also borne out by actual experience in practice.

In the case of some tumors, particularly a tumor of the chest, the effects were induced by the use of a relatively large quantity of medium wave-length radiations, and in the case of a sarcoma of the mediastinum, which was treated first by radium and later by roentgen-rays, the action of the latter appeared to be much more rapid and quite as efficient as when the gamma rays from radium were employed.

It might be laid down as a definite law in radiotherapeutics that the most suitable wave-length for general use should be that which is absorbed in the tissues undergoing treatment. The need for an increase of the penetrating power of the radiation is conditioned by the depth at which the tumor is situated, rather than by any greater effectiveness of the shorter wave-length radiation. As the depth increases the wave-length must be shortened in order to get into the area a sufficient quantity of radiation to influence the tissues. Drew's method for the differentiation of tissue-cells for experimental purposes shows that the ultraviolet ray is equally efficient for the destruction of normal and tumor cells, so long as it can be applied to the tissues in a sufficient dose.

It is not at all my object to attempt to prove that the short wave-length radiation is useless—far from it. The whole range of wave-length from the ultraviolet to the most penetrating gamma ray of radium should be at the disposal of the radiotherapeutist, in such a form that he may use any particular wave in sufficient quantity to produce the result. The most successful will be he who uses the tool at his hand to most advantage, gauging the dose of each value in wave-lengths to suit the condition he treats. Do not let us become obsessed by the idea that to obtain results we must ever increase the output from our apparatus and step by step increase the voltage until we are in a position to turn out roentgen rays equal to the hardest gamma ray of radium in hitherto unthought of dimensions.

An intelligent appreciation of the conditions requiring treatment and of the biological reaction of tissues should enable us to obtain results with much less exacting demands upon our apparatus than would otherwise be the case. Remember that the quantity as well as the quality influences the effect, and that from the results quoted a great deal can be done with what are regarded as "soft rays" provided, always, it is possible to ensure that a sufficient quantity shall be absorbed. The need for intimate knowledge of the biological properties of living tissues, the physiological action of organs, and above all a knowledge of the pathological processes concerned in disease, and particularly in those conditions known as new growth, is evident. Until this has been mastered, little real progress in the radiotherapy of cancer can be made.

It is on this account that the publications of Dr. Drew, so full of significance in the study of cell growth, and the investigations of tumors grown under similar conditions, give a clear indication of the direction in which research in radiation effects should proceed. It is a study of the living cell in artificial environments, but sufficiently indicative of the processes of development of tumor cells. An extension of this work, such as the observation of the effects of radiations upon isolated groups of cells, must yield valuable data for the investigation of this important subject.

Cultures of tumor cells could be subjected to doses of radiations and the changes noted. In this way it is probable that the question of wave-length and selective absorption would be solved. There does not appear to be any doubt that radiations of any wave-lengths, if given in the correct dose, will kill either tumor cells or normal tissue cells. In Drew's experiments on both forms of cell, the ultraviolet radiations kill in about ten minutes. It would be interesting to continue the investigations under similar conditions, using a progressive selection of radiations of shorter and shorter wave-length up to the gamma-ray of radium. The correct dose for each change of wave-length would be ascertained. If even experimentally it could be settled that it is possible to destroy particular cells by any wave-length of radiation, and if the dose of each wave-length for each specific cell could be ascertained, then it would in practical therapeutics become a question of which

wave-length to employ in a particular case; as already stated, the selection of the wave-length would, in our opinion, largely depend upon the depth of the tissue from the surface of the body. These experiments would, it is believed, confirm the opinion expressed by a number of radiologists and physicists, that it is not always necessary to employ the most penetrating radiation to achieve success in the treatment of all forms of tumor cell, the determining factor in the selection being the difficulty of reaching a deeply seated tumor with the radiations of longer wave-length, rather than any selective action of a particular wave-length radiation upon a particular type of tumor. That this contention is correct is borne out by the clinical results obtained in a number of tumors of different types, in the writer's own experience, in favor of the use of radiations of medium penetration.

The question of the duration of the exposure is also of importance; it is not always necessary to give one large dose at one sitting in an endeavor to administer a lethal effect. The injurious effects upon the patient are a contraindication to such heroic treatment. Surely a method of treatment which may so severely damage the normal tissues that further treatment cannot be given for six or eight weeks is not only unnecessary, but entirely unscientific, and particularly undesirable if the *desired* effects can be induced by any other means.

In my own practice I have given very large doses spread over three or four weeks, in several instances amounting to forty hours in all. In a number of patients this line of treatment has given results quite comparable with those claimed for the lethal dose in one sitting. In radium-therapy, for instance, a most successful case of cervical carcinoma received a radium exposure lasting for seven days. The quantity of radium was small and used in needles buried in the growth. The patient was seen five years after the treatment, and she was absolutely free from the growth, and in perfect health.

My colleague, Mr. Cecil Rowntree, quotes a case of sarcoma of the cervical glands in which he left a small radium tube in the midst of the growth for twenty one days. The result was very striking, in that there was complete disappearance of the growth for a considerable time. An example of the success of the divided dose is seen in a case of a large secondary sarcoma of the left scapula; this was treated surgically, and radium tubes buried in the mass on ten occasions, with intervals of six weeks. The tumor has completely disappeared. This patient had an amputation of the right arm at the shoulder joint as long ago as five years.

The point I am stressing in radiation therapy is a plea for the use of common sense in the development of technique. Before a very large single dose is considered to be necessary for the cure or relief of the disease, surely it would be well to consider the natural processes of cure, and attempt to assist those processes rather than to emulate the surgeon, and knock out the growth at one blow. It is well to remember that there is one striking difference between the act of the surgeon and that of the radiologist. The former removes the tumor at one attack, there is a short period of shock, and a gradual recovery. In an attempt to do the same by radiation treatment, it is not possible to remove the tumor; it may be killed by one dose, but the tumor is not removed for some time; toxic effects are induced, and these may very seriously imperil life during the interval between the treatment and the disappearance of the tumor. From a practical point of view there can be no question of choice when a tumor is accessible—surgery is the better method.

The method of the smaller dose at frequent intervals is one which has had an extended trial, and by which results have been achieved. As a sequence to the observations of the method of the small dose given over a long period, it was also realized that if the total large dose could be divided and given at frequent intervals, and the action kept up for a considerable period of time, the result might be obtained with less risk to the patient, and, reasoning on physiological grounds, much more effectively. The object is to induce an action in the tissues, which will be beneficial, and because it acts as a stimulation of

the reparative powers of the tissues in their fight against the invading cells, it is a more rational method than one which aims at a lethal effect upon the tumor at one sitting.

An effect of continuous action was hoped for by frequent small doses, administered daily, or every other day, or at longer intervals according to the effect observed. A large number of cases were treated by this technique; some patients received a dose of twenty to thirty or even forty hours' exposure, spread over several weeks or months. The results in a number of cases were very encouraging. Patients suffering from blood diseases, lymphadenoma, sarcoma and carcinoma were treated in this way. The idea was to keep up a continuous action by stimulating doses, by the administration of regularly intermittent doses. By the use of a technique of this kind, it was possible in a number of cases to get curative effects equal to or better than those claimed for the lethal dose at one sitting, with much less risk to the patient.

Dr. I. Seth Hirsch working on the same idea has subjected patients to continuous radiation for as many as fifty-six hours at one séance. He is evidently aiming at the same effect, but it is obvious that if the action can be kept up by the intermittent dose, it is preferable to the long dose at one exposure.

The underlying principle in the technique of Dr. Hirsch and that outlined in this article is the same, namely, that if the tumor cells are vulnerable at a particular phase of their life history, it is necessary to have the action of the rays acting on the tumor mass for a considerable period if we are to hope for success. If the effect can be induced by what might be called continuous biological reaction, as a result of repeated stimulation by regular doses at short intervals, instead of in one very long and obviously trying séance, then the frequent dose method is to be preferred. It does not matter whether the effect is produced by a lethal action on the tumor, or a stimulating one on the tissues. A technique of this order appears to be a nearer approach to the attainment of the natural cure of cancer described by Sampson Handley than the more strenuous one advocated by the believers in the lethal dose theory.

The great advance that has been made possible by the production of powerful apparatus and tubes capable of sustaining a high voltage current for long periods of time, enables us to use a very penetrating radiation in quantities sufficiently great to ensure the saturation of a tumor situated at any depth within the body. A technique which will allow of the utilization of such powerful radiations to the best advantage and with the minimum of risk has still to be found. It is obvious that great care must be exercised in the execution of the technique; our apparatus must be built on sound lines, and be capable of great accuracy of adjustment. The need for precision was recognized prior to 1915, when, at the Cancer Hospital, a method was evolved of which I wish to speak briefly.

DEVELOPMENT OF APPARATUS AND TECHNIQUE

Quite early in the development of radiation therapy in the treatment of cancer and other tumors and diseases it was realized that surely if slowly a rational method of treatment would be evolved from the purely empirical technique of the earlier days. Particularly in the so-called deep therapy was it felt that if the treatment was to be established on a sound foundation, a great deal of experimental work would have to be done. In England, for example, the need for precise methods of measurement was forced upon us, and quite early it was thought that the exact ionization method of the physicist must sooner or later become a clinical method. The many ports of entry paved the way for a more precise method of administering the rays, which was described in the Archives of Radiology in 1915.[17] In that paper the problem of deep therapy was entered into, and an apparatus described which would permit the administration of a dose of roentgen rays at practically any depth of the body. Observations of the action upon superficial lesions were utilized; it was observed that a little over a pastille dose on the skin had cleared up a case of superficial epithelioma, and it was assumed

that if a similar dose could be administered at a certain depth, the same result would follow. In an endeavor to work out this problem, a considerable amount of experimental work was done with, for that time, a penetrating radiation through air and beef. An ingenious method of rotating the tube was worked out with the aid of Mr. C. E. S. Phillips and Mr. A. St. George Caulfeild. The tube, if set at an angle and rotated to describe a circle upon the skin, gave a beam of rays in the form of an inverted cone. The apex of the cone represents the crossing of the beam as it passes from the circle on the skin, and also represents the sum total of the converging beam. This can be recognized as the point of maximum intensity. It was calculated that with such a voltage as we then used, the time taken to give a little more than a pastille or erythema dose at a depth of four inches would be between three and four hours. Unfortunately the war effectually prevented any further developments of this technique. Quite recently the rotatory tube has been replaced by the rotating table, upon which the patient is moved slowly around. The effect is precisely the same, and this is the final development of this part of the technique. If it is considered desirable, a single large dose can be administered with absolute precision to any selected spot in the body. The apparatus and technique are described in an article by the author previously published elsewhere.[16]

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DISCUSSION

Dr. G. E. Richards, Toronto. It is a very great honor to be permitted to express my appreciation of the privilege of hearing a paper of this character by so eminent a visitor as Dr. Knox.

In the first place, I would like to say how great a pleasure it has been to hear Dr. Knox in this country, a pleasure which we have been looking forward to for many years. Last year, in company with Dr. Hickey and Dr. Crane, it was my privilege to visit Dr. Knox in his department and to see some of the work which he has described to us tonight.

It is not possible, nor would it be fitting for me to attempt to discuss Dr. Knox's paper. I want to exercise the privilege of youth to sit and listen to others who are competent to discuss the points which he has raised.

It does, however, seem possible that we can appreciate the points which he has raised as being logical, as being along the line of our own clinical observations in many of these cases. Even before the advent of the high-power, so-called, short-wave-therapy, we were occasionally observing the effects to which he has referred. The probability is that if our records had been developed along that line, great progress would have been made. The advent of possibilities of accurate measurement, the possession of radiation of a variety of wave-lengths, opened up an entirely new field, which we have pursued aggressively, but with many disappointments.

It now seems that the pendulum swings back again to the avenue of common sense, and along the line of nature's own hint to us in all her processes. The surgeon is the only privileged mortal who can entirely ignore nature's slow and gradual processes of repair and at a single stroke undo or remove what nature has been able to accomplish over a period of long months of effort.

If what Dr. Knox has indicated to us proves to be the line along which our work will find a satisfactory solution, then it does seem to make many of our problems more simple. One may even presume to regret that Dr. Knox has not entered into some of the practical problems of our every-day work. I venture to believe that radiation sickness in Dr. Knox's divided doses is not a problem. I think that a great many of us are finding a practical solution of the terrible difficulty of radiation sickness in a modification of the intensive method, and that we are practicing to some extent a modification of the teaching of some years ago. All of us have observed the fact that if we divide the dose over a number of shorter exposures, the sickness is reduced materially. I admit that I haven't had the courage to follow that to the logical conclusion and to adopt frankly a divided dose method of treatment. I shall go home from this meeting with renewed courage to do so, and to believe that by saving the patient the great inconvenience of the sickness caused by the intensive dose, we may still hope to obtain the type of result which compares very favorably with even the best that can be secured by the more intensive irradiation.

Mr. Chairman, you took me unawares, and all that I have to say is summed up in an expression of appreciation to Dr. Knox for this excellent and wonderful paper, and for the privilege and pleasure which it has been to be present and to hear Dr. Knox address us in this country and to renew the personal pleasure of his acquaintance.

Dr. A. C. Christie, Washington. I must say, with Dr. Richards, that it would be quite presumptuous on my part to attempt to discuss Dr. Knox's paper. It gives me very great pleasure to have the opportunity of thanking Dr. Knox for it, and to say how gratified we all are to have him here in this country with us. We have been hearing about him for a long time, reading his books and his papers, and have appreciated very greatly his work; it certainly is a great pleasure to all of us to meet him personally.

I think I will not attempt at all to speak of the work of Dr. Knox in this particular field. It does seem, however, that it opens up to us a new line of procedure that our own work has more or less been pointing out to us, especially the clinical results that we have been getting. The results obtained by those who have been using the new high voltage apparatus, but who have been giving divided doses certainly seem to indicate that just as much may be expected from this method as from the more radical one of the intensive dose, and this with much less immediate discomfort and danger to the patient.

I certainly shall not attempt to go further in discussing Dr. Knox's paper. I just wish to express again the great pleasure that it has been to me, personally, and I am sure to all of us in this Society, to have Dr. Knox here.

Dr. G. E. Pfahler, Philadelphia. I also feel quite certain that every one of us appreciates the great honor in hearing from Dr. Knox and to have him visit us and to permit us to shake his hand and to become better acquainted with him. We have been reading of his work and we believe that he is one of the greatest men in this line of work, not only in England, but in the world. Therefore, when he gives us a paper of this kind, we recognize that it is a review of the whole subject of radiotherapy in connection with the treatment of malignant disease. I think all of us who are in the neighborhood of Doctor Knox's age have had experiences very much like his. We all have seen patients get well of apparently hopeless conditions, malignant disease, from small, fractional doses of rather long wave-length, which in the light of these massive doses that we sometimes give today would certainly be considered stimulating doses, and yet they didn't stimulate, the patients got rid of the disease.

Now others have unquestionably gotten patients well with massive doses, and the results that both they and we have secured by the massive dose treatment have led to an unusual amount of enthusiasm. Therefore, we must conclude that there is also value in that line of treatment. Which is the better remains for us to prove, and I am not sure that we will prove it clinically. I am inclined to think that this very excellent work that is being done now by our skilful biologists in their interest in radiation may help to solve the problem.

We have before us the problem as to whether we will accomplish most by repeated doses, extended over a considerable time, or massive doses given in a short time. The new Coolidge tube is evidently designed with the thought that the greatest amount of radiation that can be put into the tumor tissue in the shortest period of time is the one that will produce the best results. That may be true. There is a

theory at the basis of that that justifies such a procedure. We have all seen cases clinically that have responded for a short time, apparently brilliantly, and then they develop a resistance, and the more radiation you put on makes little difference, the disease goes right on and the patient dies.

The theory, then, that a massive dose, given at the very beginning, probably would have cured that patient has led to this development, and there may be, and probably is, some truth in that.

Other experiences would seem to indicate to the contrary. Professor Regaud, proceeds along the line of a long-continued, very minute dose, with the idea of killing the cells in their process of division. That is the theory of it, that you destroy the cells in process of division, and if you continue to destroy those cells in their process of division ultimately their destruction will be complete, because the older cells cannot reproduce and will finally die, and the tumor is cured. On that theory Professor Regaud now introduces, not a large quantity of radium into the tumor at one time, but very small quantities, and radium needles, not radium emanations, so as to get gamma radiation in small quantities distributed through the tumor over a long period of time. Last summer I saw him introduce into a cheek a series of needles. They had been in five days when I saw the case. Then he took out those needles and ran them in in the opposite direction, to get a cross-fire effect, and at the same time to secure a more prolonged action. There he is carrying out the theory of a prolonged, minute dose, over a long period of time, and is getting patients well.

The subject may also be approached from the experimental side. In one of these brilliant papers to which we have awarded prizes, Professor Mavor's paper, which is on a biological subject and which will help to solve some of these problems when the principles can be studied, there are presented the results of investigation of the physiological functions of the cells, not the cells microscopically, but in their minute function. He has watched the effects on the chromosomes of the cells, and I recall from reading the paper that he has secured the same effect, whether he used a large quantity of radiation at once or a small quantity over a long period of time. The results therefore are probably not so very different. The other problem that we have to solve, is the effect of radiation on the carcinoma tissue. Is it a destruction of the cancer cells themselves or is it some effect upon the surrounding tissue? And here again we have evidence on both sides, not only good arguments, but experimental evidence.

In the first place, the microscopic studies which show the granular degeneration, the vacuolation in cells, the progressive changes in the cancer cells, and the stimulation of the surrounding fibrous tissue which finally closes in, would lead us to think that probably the chief effect is the direct destruction of the cells.

On the other hand the brilliant work that is being done at the Rockefeller Institute seems to point to the opposite conclusion. I recall merely from memory that in one of the papers presented before the Cancer Research Meeting last winter, one of the experiments reported consisted in treating a number of mice before inoculation, with the tumors entirely absent, and the cancer inoculations in those cases failed to take, or a very small percentage of them were successful. There, of course, you have a strong argument that the cancer is killed and its growth prevented by the action on the surrounding tissue.

Now those are diametrically opposed theories, based upon diametrically opposed observations, yet they are both undoubtedly true, and sometime we will know the relative value of each. At the present time let us carry out the injunction that was given this morning in connection with Dr. Ullmann's paper, let us be physicians first of all, let us study our patients carefully from the clinical side, as to their natural physical condition, the extent of the disease as near as we can determine it both by our examinations and by our knowledge of pathology and the methods of extension, and then in the individual case adapt whatever of these methods seems best to suit that particular case. I think that that procedure is for the present clearly our line of action.

The next point in connection with this subject is to keep in mind the teachings of our own Dr. Bloodgood in teaching and helping the public to understand that the cure of cancer probably will depend upon the treatment and recognition of the conditions that lead to cancer, or of the conditions that precede cancer. If we can only teach the public to come to the physician, for treatment in the early stage, we will do much more than we will with all our most careful technique in the late stages.

DR. KNOX (closing). I don't think I need to say much more. I am entirely in agreement with What Dr. Pfahler has just said. There are arguments on both sides, and I tried to indicate the result of my own experience. I have seen the effects of very heavy radiation in carcinoma. I have given a limited number of very large doses, and it was the observation on the result of those massive doses that led us at the Cancer Hospital to modify our treatment in such a way

that we could get the results without the upsetting effect.

I will refer to one case which I saw just before I came away. It was a case of mediastinal tumor, a sarcoma, quite a large tumor, in an elderly gentleman, and I was asked by the surgeon who sent the case to me to give a large dose. This I declined. I said I would use my own technique, and I tried the divided doses. Now I gave that man a relatively large dose but I took five days to give him three and a half hours. The first day I gave him one hour, followed up on the other side of the mediastinum with another hour, and then divided the doses by half hours At the end of the fourth dose he complained of discomfort. I took the precaution of having his blood examined at once; his white cells had dropped down to 4,000, and I suspended treatment. Previous to coming to radiation treatment he had had a blood count made before an exploratory operation, done for the possible removal of the tumor. His white cells on the first count were normal, and I am perfectly certain that if I had given that man anything like six or eight hours, I should have killed him. As it turned out, his tumor disappeared. I saw him a day or two before I came away, and his mediastinum was perfectly normal. I don't expect it to remain like that, but I am perfectly satisfied that if I had been induced to give those massive doses, the patient would have died.

RADIUM AND ROENTGEN RAYS AS DIFFERENT AGENTS IN SUPERFICIAL AND DEEP THERAPY*

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WHETHER hard and soft roentgen rays and the gamma rays of radium produce the same or different biologic effects is a question which has been repeatedly raised. The same question has also been asked regarding the corpuscular alpha and beta rays, on the one hand, and the undulatory gamma and roentgen rays on the other.

The answer to this question depends to a great extent on the viewpoint taken. If the effect of the rays on tissue as a *whole* is considered, then there is no doubt that the action of soft roentgen rays is very different from that of hard roentgen rays. It is a well-known fact that some superficial diseases can be treated much better with soft than with hard roentgen rays, while others can be treated properly only with soft roentgen rays. As an illustration may be given the observation of Simpson that angiomas are very sensitive to beta and gamma rays so that they react even to very small doses, while they respond to hard roentgen rays only when very large doses are applied. Another example often cited to illustrate the different action of unfiltered and filtered roentgen rays is the observation that the range of dosage between the epilation dose and the erythema dose increases with increasing filtration. Recent observations have also shown that the skin metastases of breast carcinomas are influenced much less by heavily filtered than by lightly filtered roentgen rays. Finally, the question of which type of radiation is best suited to the treatment of carcinoma of the uterus, in particular, whether roentgen radiation or radium radiation, is asked again and again.

On the other hand, if we consider the effect on the molecule instead of on the tissue as a whole, we will get a different answer to the question of the action of rays of different wave-lengths.

It is the object of the present paper to make a small contribution from the science of physics to aid in clarifying this subject. In physics the action of rays of different wave-lengths is now well understood. For one thing we know that there is a tremendous difference between the action of rays of extremely long wave-length and those of very short wave-length.

We know that rays of long wave-length, such as visible light-rays, infra-red rays, and the electromagnetic waves used in

* Read at the Twenty-fourth Annual Meeting of THE AMERICAN ROENTGEN RAY SOCIETY, Chicago, Ill., Sept. 18–21, 1923.

diathermy, act on the molecule as a whole and produce molecular vibration, hence these rays produce only thermal effects.

The action of rays of short wave-length, namely, ultraviolet, roentgen and radium rays is very different. The latter radiations primarily affect the atoms and their constituents, the electrons, and so produce chemical and dissociative effects.

The transition from thermal action to chemical and dissociative action as the wave-length decreases, is gradual. In the visible and the ultraviolet spectrum both effects are present. With hard roentgen rays and hard radium rays the dissociative effect is predominant while the direct thermal action is negligible. Although a small fraction of the primary energy is indirectly converted into heat by the recombination of part of the ions, the dissociative effect far outweighs the heat effect. This accounts for the marked toxic effect of rays of short wave-lengths.

It is therefore quite evident that the application of rays of long wave-length and of rays of short wave-length, no matter in what energy ratio, can never lead to the same biologic reaction. However, in a given range of wave-lengths, in the range of roentgen rays for example, approximately the same biologic effect can be produced if an element of tissue is rayed in the one case with hard rays and in the other with soft rays.

This assumption is made still more plausible by the following considerations:

The transformation of the energy does not take place instantaneously, but in stages. A part of the primary energy is scattered. According to recent measurements made by A. H. Compton, the wave-length of the scattered radiation is somewhat longer than that of the incident radiation. Furthermore, a large part of the primary and also of the scattered radiation is transformed into characteristic radiation, which is independent of the wave-length of the exciting radiation and depends only on the composition of the tissues in which it is excited. Finally, each one of these radiations causes electron emission (secondary beta rays). The velocity and the range of the emitted electrons depends on the wave-length of the exciting radiation. While the velocity and the range increase as the hardness of the primary radiation is increased, it must be noted that through the medium of the characteristic radiation a partial equalization takes place. The transformation of the energy of the rays into electronic energy also takes place in steps. The electrons, moreover, lose their velocity by successive collision and at each impact produce dissociation. The latter, therefore, cannot vary a great deal with rays of different wave-length. We may even go farther and say that there cannot be any fundamental difference between corpuscular and wave motion as regards biologic effect, since the wave motion acts only indirectly through the medium of secondary corpuscular radiation.

We are led to assume, therefore, that roentgen rays of different wave-length, gamma rays, and corpuscular beta rays, produce very similar effects on the cell from the standpoint of physics. Accordingly we may expect similar, if not exactly the same, biologic effects.

However, in the preceding consideration we have not yet taken into account the different *penetration* of the rays. The beta rays of radium are extremely soft and therefore nearly totally absorbed in the first few millimeters. Besides, due to the fact that extremely small focus skin distances are used, the intensity falls off very rapidly, also, in accordance with the inverse square law.

Although the gamma rays of radium are extremely penetrating, the distribution of intensity obtained with gamma rays is a great deal more un-homogeneous than that obtained with roentgen rays, since weak radium applicators are used at very small focus-skin distances, namely from 0 to 3 cm., while the roentgen rays are applied with focus skin distances from 30 to 50 cm. The following figures illustrate the intensity distributions obtained with various applicators used in practice.

Figure 1 illustrates the intensity or energy distribution for unfiltered roentgen rays.

Figure 2 illustrates the distribution of energy for a radium capsule, filtered by 1.5 mm. brass, if 1, 2 or 3 cm. focus skin distance is used.

Figure 3 is a chart, showing the distribution of roentgen-ray intensities for deep therapy conditions, indicated by the isodosage lines.

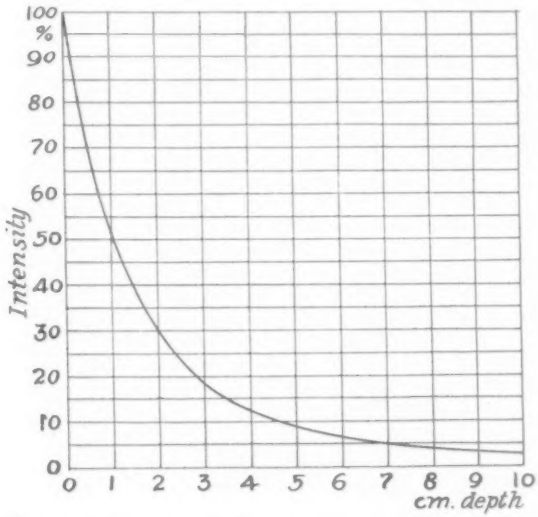


FIG. 1. Experimental intensity curves; 100 kv.; no filter; 20 cm. F.S.D ; small port of entry.

The intensity curves and the isodosage lines show that the intensity distribution in the interior varies enormously under different conditions. In some cases the

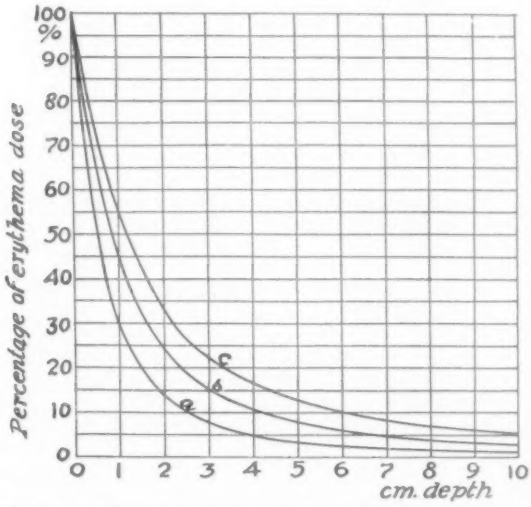


FIG. 2. Distribution curves of radium capsules in human tissue. 1.5 mm. brass filter; erythema dose designated by 100. (a) 1 cm. F.S.D., about 250–500 mgm. hrs.; (b) 2 cm. F.S.D., about 750–1500 mgm. hrs.; (c) 3 cm. F.S.D., about 1250–2500 mgm. hrs.

energy is concentrated in a few millimeters, in others, the intensity decrease is very small. By the correct combination of several fields even a homogeneous irradiation of an extended region can be attained.

It is self-evident that these physical differences must assert themselves biologically. The difference in biologic reaction in many cases is so prominent that it cannot escape observation. The best known example is the action of hard and soft roentgen rays. According to Dessauer, hard roentgen rays bear the same relation to soft roentgen rays that an extremely dilute drug does to a highly concentrated one. This is true, not because, as Dessauer assumes, that they are two different medicaments, but because they represent different space

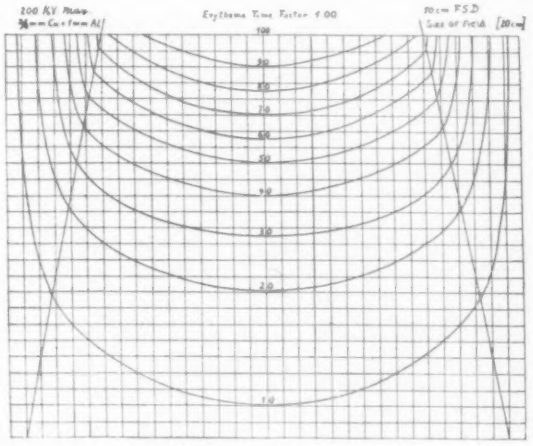


FIG. 3. Roentgen-ray distribution chart.

distributions. Hard rays can be applied only in small densities on account of their extended distribution, while soft rays can be applied in much greater concentrations on account of their localized action.

The examples cited at the beginning of this article may all be explained on the basis of the different distribution of hard and soft rays.

The angiomata mentioned by Simpson are enlarged blood vessels in the outer layers of tissue. It is evident that they are best treated with less penetrating rays. For the same reason an epilation can be carried out better with soft rays than with hard rays, since the hair follicles are at the depth of a few millimeters. Skin metastases can be treated better with soft rays, because with the latter a large dose can be

applied locally to the surface without damaging the underlying tissue.

These phenomena do not in the least prove that hard and soft rays are different medicaments, but rather show that the same medicament is applied in different concentrations. A most striking experiment in support of this view is one performed by Gudzent, who compared the alpha radiation of thorium x with extremely penetrating roentgen radiation. The same distribution was obtained in the two cases by applying the roentgen rays homogeneously and distributing the substance giving out the alpha rays uniformly through the body by means of injections. The biologic effects in the two cases were exactly alike.

With these ideas it becomes a simple matter to answer the following questions:

(*a*) Why do diathermic rays and hard roentgen rays produce different biologic effects?

Although the absorption and the distribution is approximately the same for the two types of rays, their physical action is very unlike; diathermic rays affect the molecule as a whole and therefore produce heating; roentgen rays cause dissociation of the atoms and therefore change the structure of the atoms and molecules.

(*b*) Why do hard and soft roentgen rays produce biologic effects?

While the action on the atomic constituents of the cells is approximately the same, the softer rays are more easily absorbed and therefore produce a much stronger local action than do the hard rays.

(*c*) Why do lightly filtered roentgen rays and hard radium rays produce the same biologic effect?

Although the hardness is very unlike, the distribution resulting from absorption and distance is similar in both cases, so that a strongly localized superficial action predominates over the action at a depth.

(*d*) Why is the biologic action of very soft roentgen rays similar to that of the beta rays of radium?

Although we are dealing with a wave motion on the one hand, and a corpuscular motion on the other, still within the tissues both types of rays produce ions and therefore have a dissociative effect. The distribution produced by absorption and distance is also similar in that it is very un-homogeneous. This accounts for the local effect of these two types of rays.

As a summary we may state the following general principle:

The biologic dissimilarity of rays which occupy very different positions in the scale of wave-lengths is due chiefly to their different physical or chemical (dissociative) action. The biologic dissimilarity of rays which occupy positions close together in the scale of wave-lengths is due to their different distribution in the interior of the medium, irrespective of whether the actual distribution is the result of absorption or of distance.

On the theory that all roentgen rays and radium rays represent the same medicament, but that the distribution of this medicament varies under different conditions of application, we can draw the following conclusion with regard to practical dosage:

When it is required to irradiate large regions fairly uniformly, roentgen rays are to be preferred. Radium, even under the most favorable circumstances, does not afford so homogeneous a distribution as can be attained with roentgen rays under ordinary conditions. For this reason roentgen rays should be used in the treatment of extended glandular regions, as well as in cases in which an effective action is desired at a depth, unless the region to be irradiated is accessible for radium treatment.

I would not go into this subject in such great detail except for the fact that a large number of incorrect treatment methods have come to my personal attention.

One of the first patients I saw in America had carcinoma of the rectum. The patient had been treated with a radium capsule placed on the abdominal wall, and not even an erythema had been produced. It was only after he had been treated with hard roentgen radiation that an erythema was produced in the area previously treated.

In another case I read a letter in which it was recommended to treat carcinoma of the uterus by means of radium cross fire. I was consulted in time to prevent the carrying out of this plan. According to

my calculations, the seat of the carcinoma would not have received more than 5 per cent of an erythema dose under those conditions.

A third case of an incorrect treatment method came to my attention a month ago. The inguinal glands had been treated by placing a radium capsule directly on the skin. In this way, a strong erythema had been given so that a correct treatment with roentgen rays was no longer possible.

Equally as erroneous is the other extreme of treating with roentgen rays a deep-seated tumor which requires a strong local irradiation.

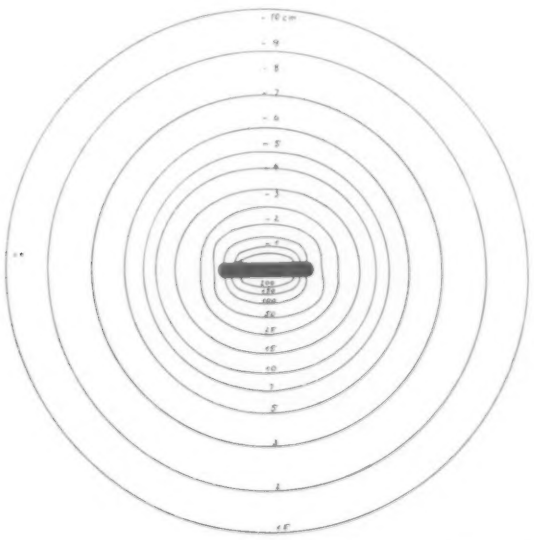


FIG. 4. Distribution chart of radium capsule, surrounded by tissue. 1.5 mm. brass filtration, 500–1000 mgm. hrs. applied; erythema dose designated by 100.

Growths of the columnar cell type, in the cervix for example, or of the squamous cell type in cases of carcinoma of the tongue, can not be treated successfully with roentgen rays. In these cases the strong local action afforded by radium must be used and a greater dose must be applied than could safely be given with roentgen rays.

A combination of roentgen ray and radium treatments is desirable in many cases, particularly those where, in addition to a strong localized irradiation of a tumor, a less intense but uniform irradiation of the surrounding tissues is required.

A method for adding roentgen ray and radium energies numerically was developed by the author in 1920. In combined radium and roentgen-ray treatment it is often desirable to know the number of milligram-hours equivalent to a given number of milliampere minutes—the word "equivalent" being used in the sense that the two produce the same skin reaction. By assigning the value 100 to the dose which produces the same skin reaction with various types of rays, a unit is determined which enables both the biological comparison and the numerical addition of different kinds of rays.

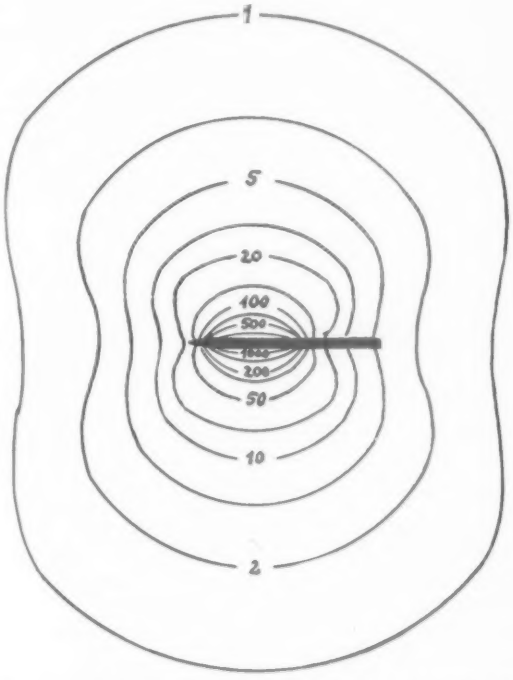


FIG. 5. Distribution chart of radium needle, surrounded by tissue, 50–100 mgm. hrs. applied. Erythema dose designated by 100.

The values for radium rays given by the author at that time (1920) referred to the strong erythema *then* widely used in Germany. Since then Failla and his coworkers have published extremely valuable tables, which enable a biological comparison in terms of the so-called "average erythema." Failla's values refer to a very weak biological reaction and are roughly half of the values published by the author.

Most of the doses actually used in practice are about midway between these two.

The best method of adding roentgen ray and radium energies consists in drawing the isodosage lines as suggested by Glasser. A few such charts are sufficient for most practical purposes.

Figure 4 indicates the isodoses of a radium capsule. The isodose 100 represents the energy which produces an erythema if 500 to 1000 mgm. hrs. are applied.

Figure 5 shows the energy distribution of a radium needle measured by the same biologic unit.

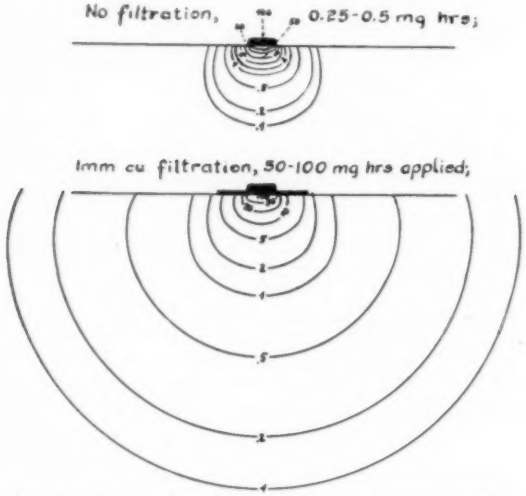


FIG. 6. Distribution chart of radium plaque; erythema dose designated by 100.

Figure 6 gives the isodoses for surface applicators in the same scale.

The values obtained with roentgen rays are taken from charts similar to those originally prepared by Dessauer. Charts for the treatment factors used in this country have been prepared by the author, by Glasser, and by Erskine. The values obtained are in close agreement.

Figure 7 shows one of the charts constructed by the author. Besides giving the distribution in both the directly rayed and the indirectly rayed regions, it shows how the distribution depends on the thickness of the patient. It has been found that the intensity at a point in a surface of emergence is one-fifth less than it would be if additional tissue were present. The author's charts have been prepared from measurements made with a large water-phantom. If any point of the chart lies in a surface of emergence, then one-fifth of the intensity given by the chart must be subtracted in order to obtain the actual intensity at that point.

The tables also give the time required with various fields to produce the same biologic reaction. If the erythema time for a large field, namely 20 cm. × 20 cm., is known, then the erythema time factor given on the chart enables the determination of the erythema time for the field in question.

The energy which produces an erythema of the skin may again be designated by 100.

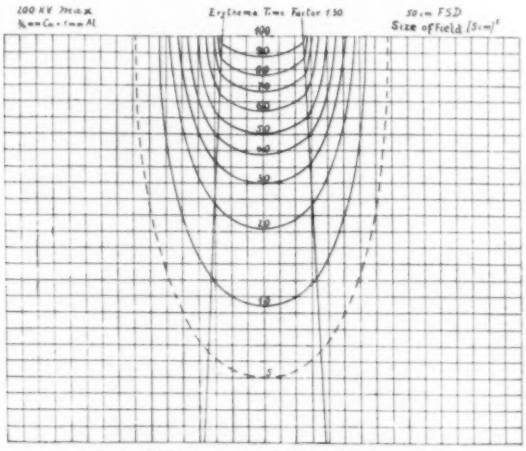


FIG. 7. Roentgen-ray distribution chart.

By the use of the above-mentioned charts the distribution of the roentgen ray and the radium energy can be determined in terms of the same biologic unit. The numerical addition of the two energies gives the total effect of the combined roentgen ray and radium treatment for any point in question.

DISCUSSION

DR. A. H. PIRIE, Montreal. I would like to ask Dr. Bachem one question. He stated the difference in the dose with soft and hard rays. Now we have all got epilation with soft rays, and with those that are using 200,000 volts and ¾ mm. of copper they get epilation just exactly the same way. As far as I see the soft and hard rays are the same. I would like to have the doctor explain what difference he makes out.

DR. BACHEM (closing). In reference to epilation, I would say this: We know that with really soft rays it takes nearly an erythema dose

to produce proper epilation. However, if we filter the rays there is a certain range between an epilation dose and an erythema dose. The harder the rays the more difference between the doses. The explanation can be easily given by the fact that in producing an erythema we produce a superficial effect. In producing an epilation we have to treat a depth of a few millimeters. With very soft rays we cannot treat the depth of a few millimeters with such a strong dose as is necessary to produce epilation. With better filtered rays we can control more accurately the dose to the part.

About measuring the proper depth dose, I gave the proper conditions about one year ago at the meeting in St. Louis, and that has been published in the *Radiological Journal*. The most important thing in this is that we use an instrument which measures the total amount of scattered and secondary rays. It is a physical question whether or not an ionization chamber measures the full amount of these rays, and our opinion is this, that a very small chamber, let us say, like the chamber of Friedrich, measures the full amount. If the chamber is too large, or is filtered too heavily by aluminum, it would not measure the full amount of scattered radiation. The measuring instrument may be a little tube filled with a photographic emulsion, it may be a photographic film, it may be a small ionization chamber. We measure the full scattered radiation as well in the depth, as on the surface. In this case we can be quite sure that we measure the proper depth distribution.

THE NEW TYPE OF HIGH-VOLTAGE ROENTGEN THERAPY IN THE TREATMENT OF CARCINOMA OF THE BLADDER*

BY CHARLES A. WATERS, M.D.

BALTIMORE, MARYLAND

WITH the introduction of the cystoscope came the first successful efforts in the handling of bladder tumors, mainly on account of the increased possibilities of earlier diagnosis, which enabled surgeons to devise methods for their removal.

The results from surgery were discouraging. However, in fully 50 per cent of the cases, the tumor could be successfully removed or destroyed by operative procedures (Fig. 1); but it was soon discovered that bladder tumors had an extremely marked tendency to recur, not at the site of removal but in other parts of the bladder. Repeated suprapubic operations were out of the question, and furthermore, the trauma resulting from the operation frequently changed relatively benign tumors to extremely malignant ones.

The introduction by Beer of fulguration in 1910 showed that the so-called benign and malignant papillomata could be successfully handled by this intravesical method of treatment with results much superior to any surgical procedure (Fig. 2).

It has been our experience that 40 to 50 per cent of all tumors appearing in the urological clinic belong to the papillomatous group. It was soon found that while fulguration was so successful in the handling of papillomata it was worse than useless in the treatment of papillary carcinoma, either superficial or infiltrating.

With the introduction of radium, experience has shown that the superficial papillary carcinomas, which comprise 15 per cent of the bladder tumors seen, could be handled by radiation, the radium being applied intravesically to the surface of the tumor (Fig. 3). No results are to be obtained by this method of radiation when the tumor is deeply or extensively infiltrating (Fig. 4).

When the superficial or non-infiltrating papillary carcinoma covers a large extent of bladder area (Fig. 5), endovesical radium treatment is quite unsatisfactory, owing to the extent of the area to be radiated.

It has been the experience in our urological clinic that 10 per cent of the infiltrating carcinomas are sufficiently localized, or occupy positions where radical resection can be carried out, as shown in Figure 1. On the other hand a tumor may be comparatively small but located on the trigone

* Read at the Twenty-fourth Annual Meeting of THE AMERICAN ROENTGEN RAY SOCIETY, Chicago, Ill., Sept. 18–21, 1923.

and involving the posterior vesical orifice in such a way that radical excision with any hope of success means the necessity of transplanting both ureters, removing the posterior portion of the prostate and excising the trigone, a procedure technically difficult and rarely justifiable (Fig. 6).

With the combination of fulguration and radium applied to the surface of the tumor through the urethra and a suprapubic excision of extensive papillary carcinoma by the cautery the maximum possibility is 75 per cent of tumors which stand any chance of being cured.

This leaves about 25 per cent of tumors occupying positions which render them inoperable or involving such extensive areas of the bladder that surgery or endovesical radium treatment offers no chance of success (Fig. 7).

The development of radium therapy has demonstrated that in a certain percentage of these hopelessly infiltrating cancers, opening the bladder suprapubically and implanting the tumor area with either emanations or the radium element will result in the destruction or elimination of the tumor.

In a series of approximately 30 hopelessly inoperable cases, radium implanted in the tumor has resulted in a cure in about 25 to 30 per cent so far as the removal of the tumor is concerned.

A warning should be given in regard to the amount of radiation that can be used in these cases. Seldom should one exceed 2500 to 3000 mg. hrs.

Recently, because of the tremendous sloughs in deep radium burns produced by the bare radium emanation tubes, we have been employing small radium element needles thoroughly screened by platinum, filters which screen out at least 95 per cent of the beta rays.

The case in which this method of implantation has been employed has given equally as satisfactory results so far as the emanation is concerned, and with the minimum burn and irritation. One can see by the statistics quoted that there still remains a large number of cases unsuitable for fulguration and endovesical radium treatment and too extensive for resection or the employment of radium needles, and in which some further therapeutic agent is needed.

It is here that deep roentgen therapy with its modern and improved methods of application seems to offer help. Of course it is too early to attempt to draw any

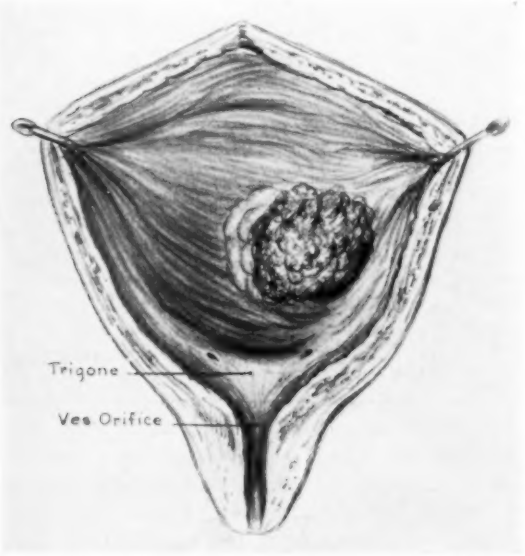


FIG. 1. A large papillary carcinoma of the bladder which is infiltrating, as shown by the edema along the inner margin. This case represents the infiltrating type which is resectable.

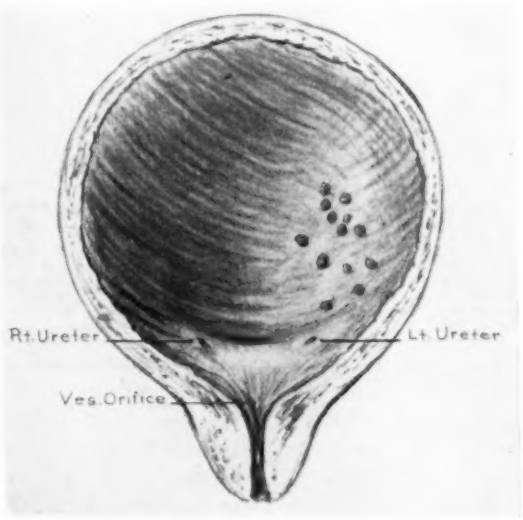


FIG. 2. Papillomata, which, when not too extensive, can be cured by fulguration. This particular case was partly relieved by deep roentgen therapy.

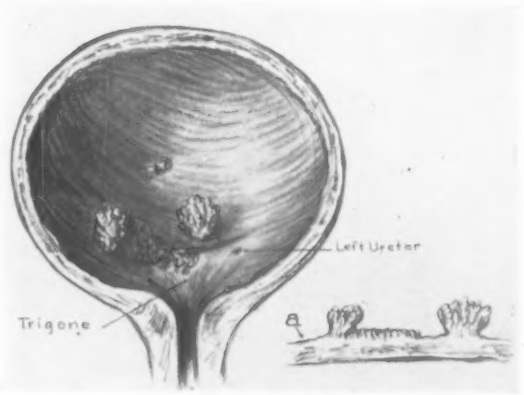


FIG. 3. This case shows the type of papillary carcinoma which is creeping along the surface of the mucosa of the bladder and in which radium alone will effect a cure.

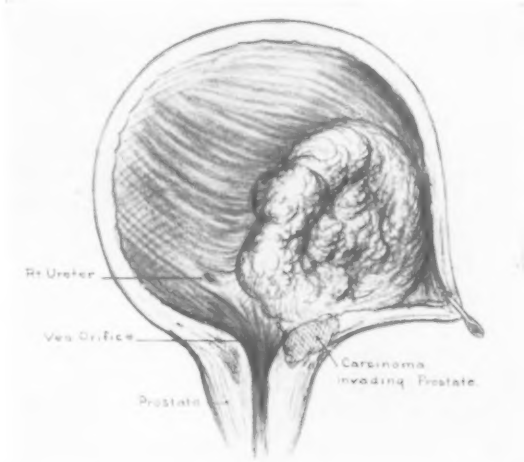


FIG. 4. A very extensive inoperable deep infiltrating carcinoma of the bladder. This patient was given, in August, 1922, a dose of 120 per cent roentgen rays into the tumor with no effect on the growth. Six months later another series of deep roentgen treatments amounting to 120 per cent failed to destroy the tumor. Two months later an incomplete series of deep roentgen treatments, amounting approximately to one-half a full cancer dose, was given and at the same time radium needles were implanted in the tumor through a suprapubic opening into the bladder. The tumor rapidly and completely disappeared in six weeks as found cystoscopically. There has been no recurrence of the tumor in six months. This case represents the type of bladder cancer which has been considered hopeless. The combination of radium and deep roentgen therapy at the same time seems to offer possibilities in cases which heretofore have been looked upon as hopeless.

absolute conclusions regarding the position that deep roentgen therapy is likely to attain in the treatment of bladder tumors.

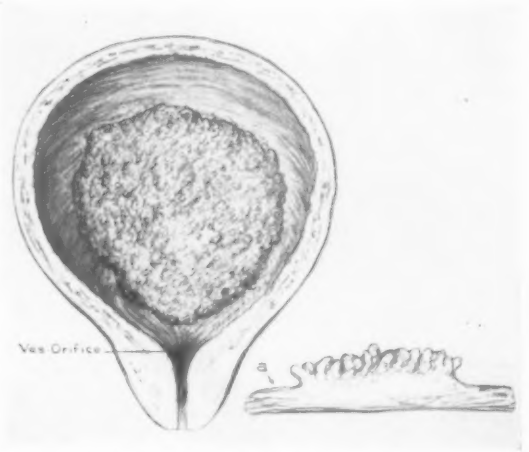


FIG. 5. A large type of papillary carcinoma of the bladder, completely destroyed by a dose of 125 per cent deep roentgen rays to the posterior bladder wall.

This much can be said positively, however, that it has a very definite beneficial and specific influence on certain types of carcinomas of the bladder.

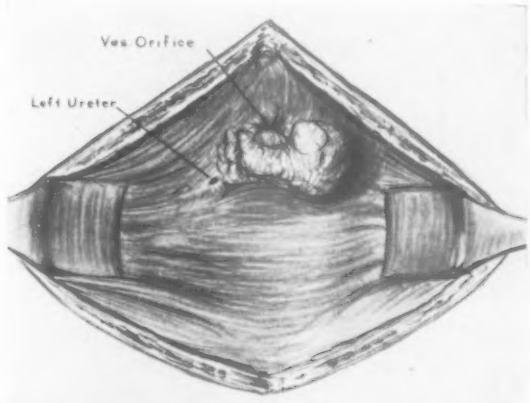


FIG. 6. This is the type of tumor which has heretofore resisted all forms of treatment. It is not resectable on account of its location, and radium in sufficient quantities to destroy the tumor causes so much edema and irritation of the bladder as to produce obstruction. It can be benefited by local applications of radium along with a dose of 130 per cent roentgen ray to the tumor.

Experience will probably show that it has a marked influence on the multiple superficial papillary carcinomas which dis-

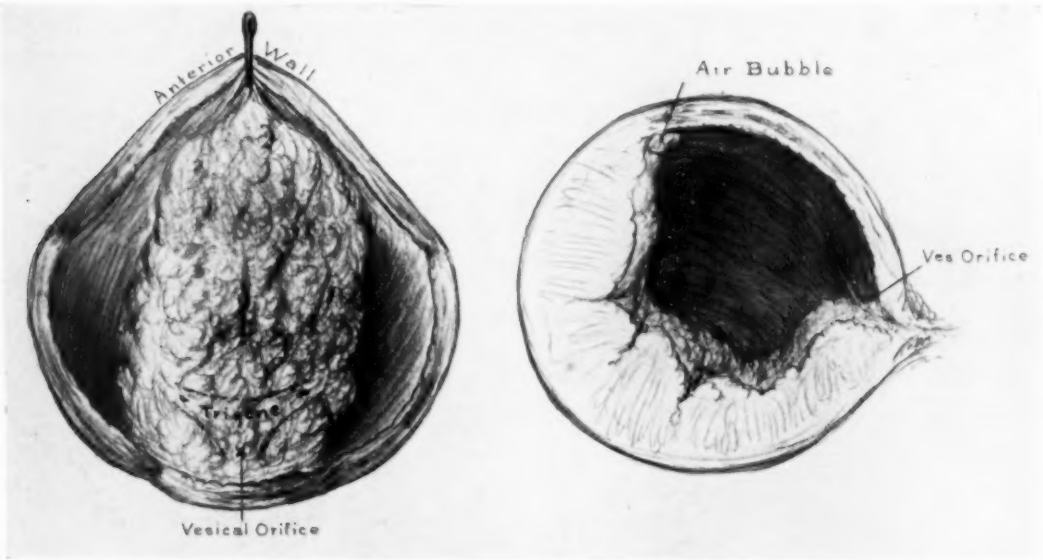


FIG. 7. This case shows a large inoperable carcinoma of the bladder, which is too extensive for surgery or radium. The only possible hope of doing anything is with deep roentgen therapy.

FIG. 8. Multiple carcinomata of the bladder which can be destroyed by radium but which recur almost as fast as they are destroyed. On account of the widespread involvement of the bladder by these tumors, intravesical radium treatments are unsatisfactory, due to the great amount of irritation produced by the radium. It is in this type of case that deep roentgen therapy has in a few instances offered brilliant results.

appear under radium but recur almost as fast as they are removed (Fig. 8). Furthermore, I think we can predict with safety that in certain types of tumors, a combination of radium and deep roentgen therapy will cause the disappearance of tumors which neither method alone would effectively handle, as shown in Figure 4.

In the cases treated successfully by deep roentgen therapy there is apparently none of the burn and slough which follows radium except when the latter is very carefully employed.

During the past eighteen months we have been employing deep roentgen therapy in a large number of all types of bladder cancer. A small group of cases have received roentgen rays alone while in the majority of the cases they have been employed along with other standard methods of treating this condition; and it is the belief of our urologists that deep roentgen therapy will occupy a definite position in the treatment of bladder tumors.

It has been our experience that deep roentgen therapy will cure a certain percentage of bladder carcinomas which are unsuitable for other forms of treatment.

One can readily see, from what has just been said, the necessity for the urologist

and roentgenologist working hand in hand because successful treatment depends upon accuracy in diagnosis.

It might be said in conclusion that the pathological study of bladder tumors has helped very little in the successful treatment of them. In our clinic we have learned that the information secured by the skilled cystoscopist plus the information and experience gained by the use of these different methods of treatment, make possible the successful treatment and ultimate cures of bladder carcinomas which were until recently looked upon as hopeless.

THE RESULTS OBTAINED AFTER TWO YEARS' APPLICATION OF DEEP ROENTGEN THERAPY IN CASES OF CANCER OF THE PROSTATE AND BLADDER*

BY CARLOS HEUSER, M.D.

BUENOS AIRES, ARGENTINA

CASES of cancer of the bladder or prostate are very common in Buenos Aires. Every specialist in urinary diseases sees several cases annually.

The cases that came under our treatment had been operated upon before they received deep roentgen treatment. In all these cases the pathological examination of the tumor was made and the diagnosis was cancer.

In another part we will discuss cases of prostatic tumors (adenoma) which we have treated with roentgen therapy because, on account of an excess of urea in the blood, they could not be operated upon.

In 6 cases of cancer of the bladder, 5 have continued to do well during two years, without evidence of any return of the cancer. The sixth case died on the first day after application of the roentgenotherapy because of the great extension of the cancerous growth in the rectum. Out of the 5 cases 1 still has blood in the urine, and the other 4 are doing well.

I will not occupy your time with details, but will state the facts of each case in a few words.

CASE I. Male, aged fifty-five. Complaint, pain in the bladder, passing blood and pus for five months. After several treatments a tumor was found and operated upon. The operation revealed a tumor which was too large to be removed. The diagnosis according to the pathological preparation made from a specimen taken for that purpose, was cancer. One month later roentgen-ray treatment was applied, and four months after the application neither blood nor pus could be detected in the urine.

Eight months after the deep-roentgen treatment, a hard tissue appeared on the walls of the abdomen and a roentgen ulcer formed. There was also keratosis in the region of the sacrum and in part of the perineum. During the last six months these ulcerations have been healing slowly.

CASE II. Male, aged sixty-two. He had been operated upon for a large tumor in the bladder, which it was impossible to remove. Deep roentgen treatment was applied.

One year after this treatment roentgen ulcers had formed on the right and left side of the femur which discharged for six months causing great pain, burning and general debility.

Now, six months afterwards, the ulceration is healing slowly. No blood is noticeable in the urine and the tumor is reduced. A hard fibrous tumor can be observed on the perineum.

CASE III. Male, aged eighty. Confined continuously in bed. He passed a great deal of blood and pus in the urine. He could not retain urine and needed continuous catheterization. He was operated upon; the tumor, however, was not removed—only a small part was taken out for anatomical pathological preparation.

Deep roentgen treatment was commenced five days afterwards. Eight months after the latter treatment a big roentgen ulcer in the suprapubic region had developed and another over the right condyle of

* Read at the Twenty-fourth Annual Meeting of THE AMERICAN ROENTGEN RAY SOCIETY, Chicago, Ill., Sept. 18–21, 1923.

the femur. The bladder was sound, and the urine clear without blood or pus. He had no pain and could retain about four ounces of urine.

CASE IV. Male, aged forty. He was operated upon for cancer, and after operation deep roentgen treatment was given.

One year afterwards he showed a large roentgen ulcer on the stomach in the suprapubic region and also one on the perineum. For eight months after the deep roentgen treatment he passed blood, but at present this has disappeared and the ulcers are healing. He also suffered for about two months with diarrhea as a result of the application.

CASE V. Female, aged fifty-five. Suffering from a large tumor in the bladder that caused great pain in urinating, also passing blood and pus. A part of the tumor was removed with the aid of the cystoscope and, an anatomical pathological preparation having been made, the diagnosis was cancer composed of small cells.

Deep roentgen treatment was made from front, back and each side, and also from the perineal region by means of my specially constructed chair for deep roentgen treatment.

One year after this application the patient complained of the formation of a roentgen ulcer on the vulva and in the suprapubic region. At the time of writing this paper she has improved greatly; neither pus nor blood occur in the urine, and she is on the way to recovery.

In this connection I would like to state that my specially constructed chair greatly facilitates the application of deep roentgen treatment to the perineal region and also to diseases of the vulva and anus. With the chair five different regions can be exposed to the roentgen treatment. It is to be recommended that the patient should bend forward in a sitting position so that the rays have a better action on the tumor, not, however, because he would be in a better position for exposure, but because he will remain quiet.

While I would not base a definite opinion of the efficacy of this treatment in general, on a few cases such as these I may state that the results obtained have been highly satisfactory, especially where surgical operations have been valueless.

DISCUSSION[1]

DR. GOOSMANN, Cincinnati. I had the privilege of reading a paper on the subject of tumor of the bladder at the Louisville meeting of the Middle Section. That paper will be published shortly in the Journal. We had 15 cases in the first year of high voltage *x*-ray treatment. Of the 15 cases, in 9 we had a primary recovery. That is, the cystoscopic examination showed no evidence of the tumor after treatment. We had no *x*-ray ulcers.

The last case included in that report was treated, I think, in November, 1922. I am not anticipating any ulcers, but I assure you that if I have them, I am going to change my technique.

DR. D. Y. KEITH, Louisville. The first case reported by Dr. Waters is very interesting from the standpoint of filtration. He did not mention the screen used in his first radium application, but it is evident that silver filtration was used.

This patient received an application of radium inside the bladder through a cystoscope and a series of deep roentgen-ray treatments, followed a few weeks later with a similar series of deep therapy, using copper filtration, with no response. He came back showing no improvement, and by the implantation of needles, in which the filtration was very little, if any, the tumor receiving alpha, beta and gamma rays, entirely disappeared. From our personal experience we believe the future of the treatment of neoplasms will be in using the proper filtration, as well as the proper voltage.

About two and one-half years ago, when we first began to use ½ mm. of copper filtration with 110 kv., a blonde patient with a recurrence of a breast malignancy along the line of incision with metastasis in the axilla, received a maximum dose, with copper filtration, from the posterior field of entry and a similar dose from the anterior field. In one of these treatments thirty minutes was given using only one piece of photographic glass and ½ mm. of aluminum at a 14 in. anode skin distance; this, of course, occurred by accident, as the filters were left out. Much to our surprise the reaction was not so marked as we had expected. The recurrent nodules in the skin and the axillary metastasis entirely disappeared. The patient is alive and free from recurrence today.

Since this experience we experimented with our superficial malignancies about the nose and face, using different filters during *x*-ray and

[1] This discussion has reference to the preceding paper by Dr. Waters, as well as to the above.

radium exposures, and we are firmly convinced that complete regression from this type of radiation is much quicker than with any other filtration used. If anyone here has been using filtration of this type, we would be glad to hear from them. If not, we would like some of you who are interested to try this method of treatment and report at a later meeting.

DR. WATERS (closing). There is little I can add in closing. There are so many phases to the treatment of carcinoma of the bladder, namely, the type of tumor, its size, location, and so forth, that I have only tried briefly to bring to your attention what has already been done generally and to indicate the aid one might hope to expect in the relief of this condition by the employment of deep *x*-ray therapy.

The question of the use of fractional versus the large massive doses offers an interesting subject. I have used only the open tube stand and it has been impossible for me to give treatments longer than forty-five minutes on account of the apparently increased absorption of scattered radiation. If the longer massive doses are used I feel sure that your patients will get so much absorption that they will never recover from the severe prostration.

I believe the occurrence of an aplastic anemia by using the open tube stand is a much more likely and serious complication than with the closed stand. In order to get 130 per cent into the bladder tumor we find that almost always the white blood count comes down to from 3,500 to 4,000, and many of these cases start with comparatively low white blood counts and of course their reduction is in proportion. If you do not make blood counts every few days, you are bound to get these aplastic anemias and apparently nothing will cause the blood to regenerate.

HYDRONEPHROSIS*

BY BERNARD H. NICHOLS, M.D.

CLEVELAND, OHIO

IN our clinic a study of the histories of cases of hydronephrosis shows that in more than 30 per cent a previous operation had been performed for cholelithiasis or appendicitis without subsequent relief of the symptoms. Such a simulation of symptoms in appendicitis, gall-bladder disease and right-sided hydronephrosis indicates clearly the importance of pyelography in the determination of the differential diagnosis.

Cabot pointed out in 1913 that in many cases a pyelogram of the suspected kidney is the only means by which an early hydronephrosis can be diagnosed. If this is true of early hydronephrosis it is evident that the diagnosis of the later stages of the disease can easily be confirmed by the same method.

Hydronephrosis is a retention of urine in the kidney pelvis due to obstruction either in the kidney or in the ureter, with a resulting dilatation of the calyces and kidney pelvis followed by atrophy of the kidney cortex. Occasionally also stones in a calyx or stricture of the infundibulum may produce a localized hydronephrosis of one calyx (Fig. 7). This brief statement regarding the nature of the condition suggests that before discussing the interpretation of the roentgenological finding, it will be well to consider briefly the structure and normal anatomical supports of the kidney and ureter. The principal divisions of the kidney are the cortex and the pelvis with its major and minor calyces. The pelvis is pyramid-shaped like a funnel with its apex toward the uretero-pelvic junction; at its base, the pelvis divides into the major calyces, which are usually three in number—upper, middle and lower. The major calyces in turn are somewhat pyramidal in shape with their bases toward the periphery of the kidney, and in turn are subdivided into the minor calyces.

In different individuals the kidney pelvis may vary greatly in shape and size. Its shape may be comparatively spherical (Fig. 1 B), square (Fig. 2 D), long or tubular (Fig. 1 C). The major calyces may unite so as to form its greater portion (Fig. 2 A), or the major calyces may be practically absent so that the pelvis leads directly into the minor calyces (Fig. 2 D). The capacity of the pelvis is usually greater than that of the calyces combined (Fig. 1 B) although in some cases it may be much smaller (Fig. 2 A). If the pelvis is large,

* Read at the Twenty-fourth Annual Meeting of THE AMERICAN ROENTGEN RAY SOCIETY, Chicago, Ill., Sept. 18–21, 1923.

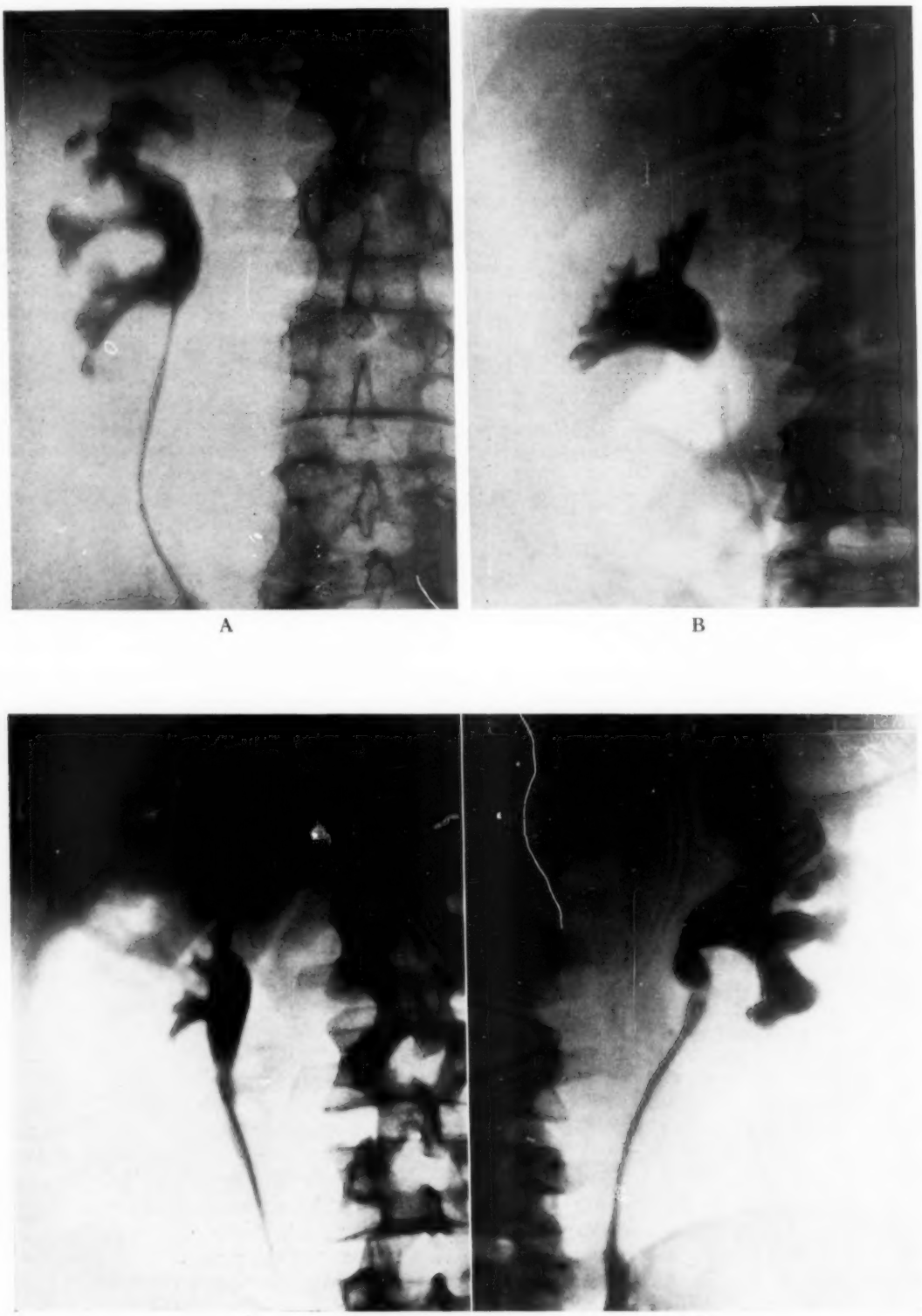
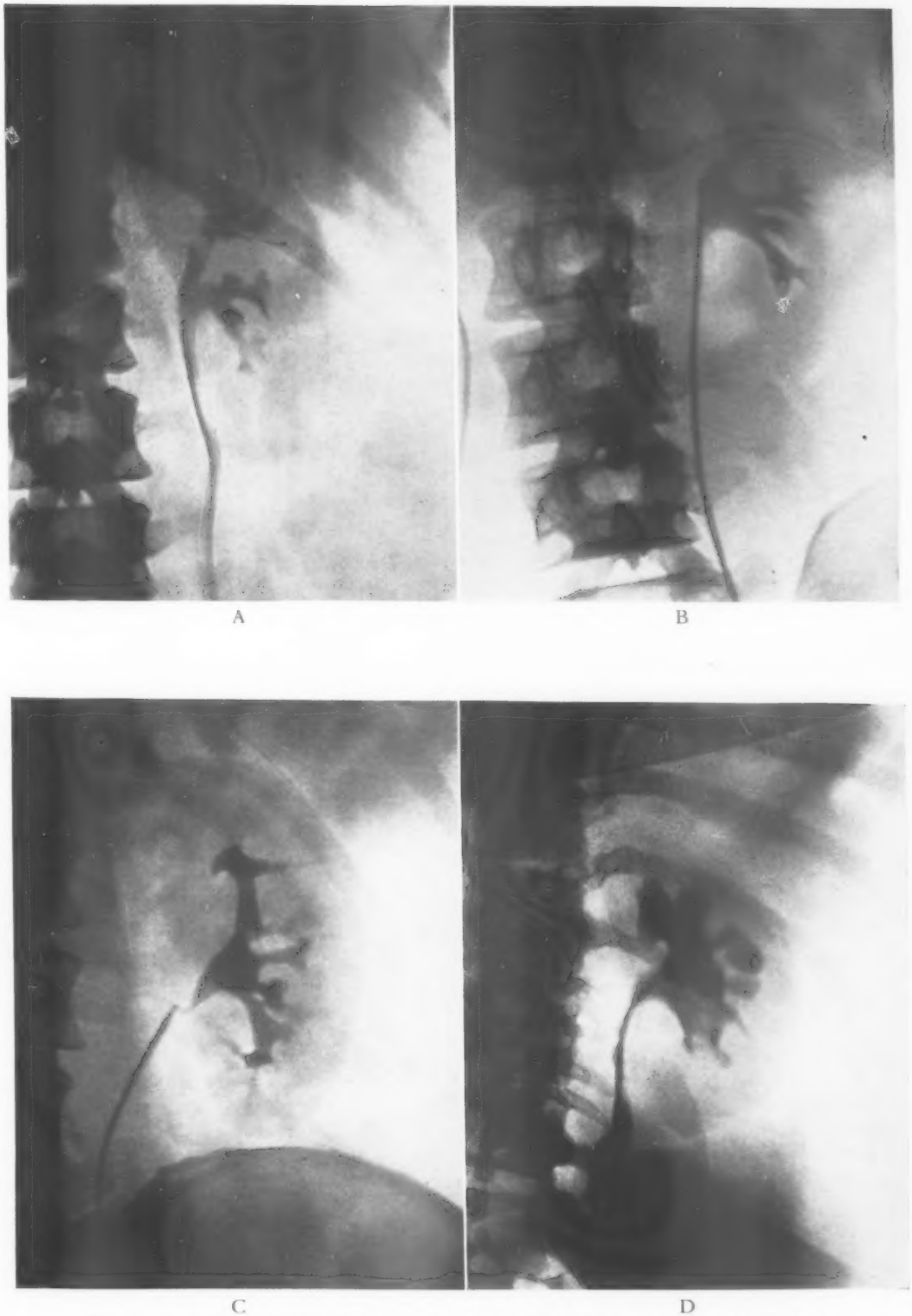
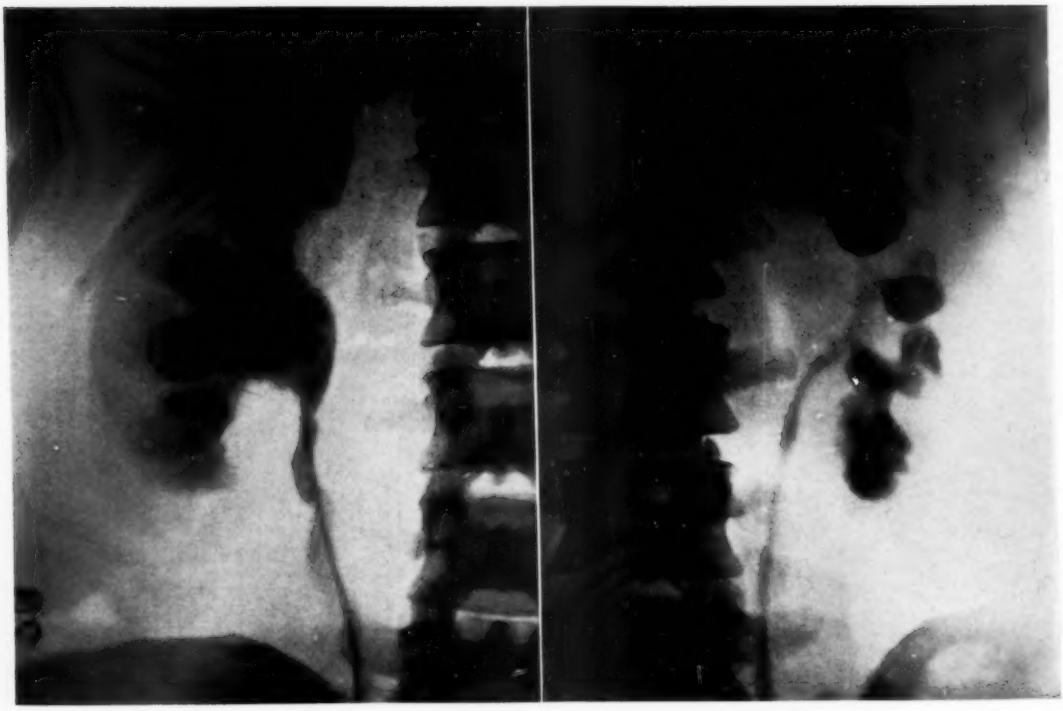


FIG. 1. Pyelograms showing variations in the shape and size of the normal kidney pelvis.



A B C D

FIG. 2. Pyelograms showing variations in the shape and size of the normal kidney pelvis.



A B

FIG. 3 A and B. Pyelograms of infected kidney.

FIG. 3 C. Infected kidney with hydronephrosis after nephrectomy.

FIG. 3 D. Pyelogram of C showing dilated pelvis and obliteration of calyces in the lower pole due to infection and resecting scar-tissue contractions.

there is usually not a corresponding enlargement of the calyces. On the other hand, when the pelvis is small the calyces usually are correspondingly small.

Normally, in most individuals, the capacity of the pelvis is the same in both kidneys, although occasionally the capacity of one pelvis may be much larger than that of the other. Normally, the kidney pelvis extends somewhat downward and toward the spine; in a case of rotation of the kidney, however, its position may be reversed (Fig. 4 B C D and E).

The major calyces, extending from the pelvis toward the periphery, may assume a variety of shapes and sizes, and any one of them may be longer than its fellows. While they are usually three in number, in some individuals there may be only two and in others, there may be four. In some instances a calyx may be divided into two, or more subdivisions. The middle calyx may be small or rudimentary or may be absent. Roentgenograms will often show an apparent anastomosis of the major calyces but on examination of the kidney after its removal this is found to be due to a superimposing of the shadows of the injected calyces.

The minor calyces which also are somewhat pyramidal in appearance are formed by the projection of the minor papillae into the ends of the calyces, their bases thus acquiring a somewhat cup-shaped appearance with sharp clean-cut edges. In the roentgenogram, however, an end view of some of these is presented, so that they produce a rounded dense shadow not unlike a calculus in appearance.

The above descriptive notes give a general perspective of the great variety of appearances of normal kidney pelves with which the roentgenologist must be familiar before he can interpret pathological changes.

It is important also to understand the normal suspension and fixation of the kidney and ureter. The kidney is held in position by the adipose capsule, the renal fascia and the intra-abdominal pressure of the neighboring viscera. The ureter is supported independently of the kidney by its fixation anteriorly to the surface of the peritoneum. This is an important point to bear in mind in the consideration of kinks in the ureter as a causative factor of hydronephrosis.

An understanding of the possible etiological factors is essential to the correct interpretation of pyelograms made for the determination of a hydronephrosis.

1. *Abnormal Renal and Ureteral Development.* Only such abnormalities as are demonstrable by urography are pertinent to this study. These, which range from a slight deviation from the normal to a pronounced degree of abnormality include the following:

(*a*) Duplication of the renal pelvis.
(*b*) Dystopic or pelvic kidney.
(*c*) Double or bifurcated ureter.
(*d*) Fused or horseshoe kidney.
(*e*) Congenital increase or decrease in the size of the kidney pelvis.

2. *Acquired Abnormal Conditions.*
(*a*) Renal mobility, resulting in movable kidney.
(*b*) Renal torsion.
(*c*) Pelvic kidney.
(*d*) Aberrant vessel not demonstrable by roentgen examination (Fig. 6).

3. *Active Etiological Factors.*
(*a*) Infection—commonly colon bacillus infection, or tuberculosis (Fig. 3).
(*b*) Trauma.

Long-continued colon bacillus infection in many cases produces renal mobility or a sagging of the kidneys which is responsible for the obstruction of the urinary flow and the resultant dilatation of the kidney pelvis. Some cases show a developmental anomaly in conjunction with the infection, which was either the cause or at least a contributing factor in the process of development of the condition. Tuberculosis usually results in dilatation of the kidney pelvis, in areas of cortical necrosis, and in stricture of the ureter. However, if the infection is confined to the cortex the pelvis may become smaller, with a resultant contraction. If stricture of the ureter occurs, then obstruction with dilatation is the result. The irregular outline of the kidney pelvis which often results from tuberculosis has been described by Braasch as having a "moth-eaten appearance" (Fig. 3 B).

FIG. 4 A. Hydronephrosis and hydro-ureter due to old cystitis with patulous uretero-vesical orifice

FIG. 4 B. Hydronephrosis in ectopic kidney.

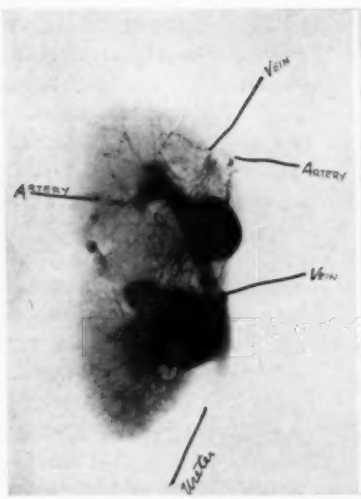


FIG. 4 C. Roentgenogram of kidney shown in B after removal.

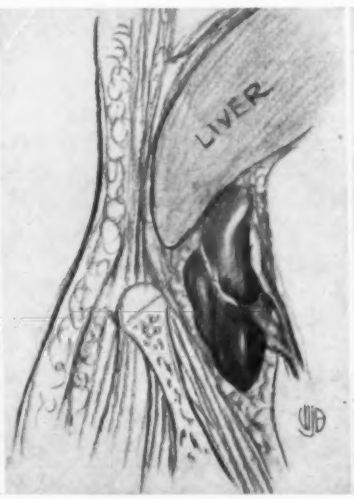


FIG. 4 D. Drawing of kidney shown in B as it appeared at operation.

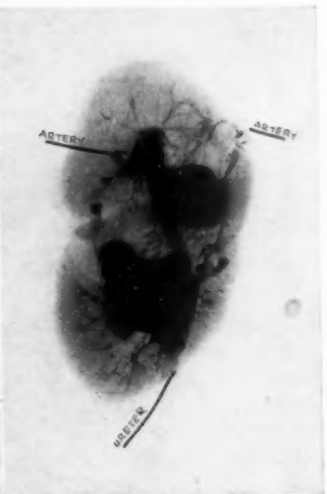
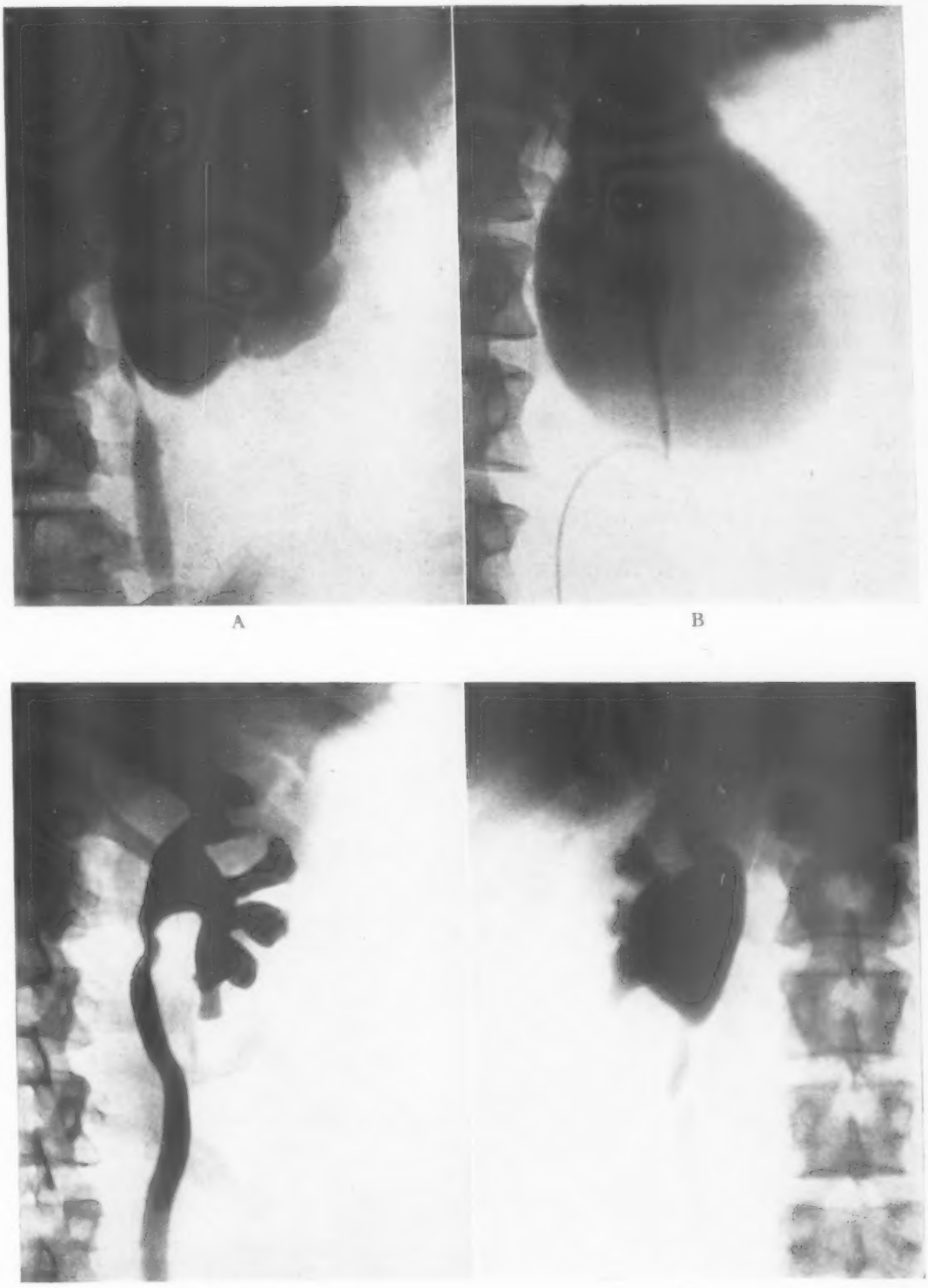


FIG. 4 E. Roentgenogram of kidney shown in B after removal.



A B C D

FIG. 5. Pyelograms showing hydronephrosis of the obstructive type.

4. *Direct Etiological Factors.*

(*a*) Obstruction — Strictures, Stones, Tumors

(*b*) Motor insufficiency with a patent uretero-vesical orifice such as is seen in an old hydronephrosis following a chronic cystitis (Fig. 4 A).

(*c*) Central nerve crises.

These conditions include the more important etiological factors in the production of hydronephrosis.

The essential technique for the demonstration of a hydronephrosis must be properly carried out, particularly in early cases. If possible, all residual urine should first be drained from the pelvis of the kidney as it is necessary that the injection completely fill the pelvis and all of the calyces. During the exposure of the films there should be no motion on the part of the patient. The films should show the minor calyces distinctly. In many cases two or more films should be exposed with the patient in different positions in order to demonstrate the mobility of the kidney. Calculi in the ureter are usually easily demonstrated, the pyelogram showing the resulting dilatation of the ureter and hydronephrosis above the stone (Plate V C).

A dilatation of the ureter below the stone is sometimes seen. This is due either to infection or to a calculus which has been passed.

A dilatation of the ureter shown by the injected medium may be the result of an unusual elasticity of the ureteral wall in a perfectly normal ureter. The ureter frequently shows angulation and kinks, which are sometimes due to mobility of the kidney. On account of the independent fixation of the ureter it does not descend with the kidney. Such conditions as these, however, cannot be considered as pathological unless pathological changes resulting from the obstruction can be seen in the kidney pelvis.

The first indication of a beginning hydronephrosis is often difficult to determine. If the kidney pelvis has a capacity of 20–25 c.c. of solution there is usually a hydronephrosis; but some normal kidney pelves are capable of being dilated to this extent, so that the capacity of the pelvis of itself alone will not determine the disease. This alone, to my mind, answers the question as to whether or not the kidney pelvis should be filled under the fluoroscope. The fluoroscopic determination of a filled kidney pelvis is of no value because an injection, to be of diagnostic value, must be continued until the patient experiences a sense of pain—the incidence of pain indicating that a sufficient quantity of the solution has been injected.

If we are satisfied that the kidney pelvis has been completely filled and one or more pyelograms have been properly made; if the history has been taken carefully and all potential etiological factors have been considered, then in the presence of positive findings we may with reasonable assurance make a diagnosis of hydronephrosis.

The first evidence of hydronephrotic changes shown by a pyelogram is a dimness of outline and inflation of the minor calyces (Plate I D) which should appear in the terminal projections of more than one of the major calyces. These appearances are in contrast to the sharp clear-cut outline of a minor calyx in a normal kidney pelvis (Fig. 1 B) and is the first change to take place in the development of hydronephrosis. The next change which may be seen is a widening of the bases of the major calyces, giving the so-called plug-hat calyx described in 1919 by Keyes (Fig. 5 C). This is followed by an enlargement of the kidney pelvis. As the pressure in the kidney continues, the major calyces become widened, not only in their bases but throughout their whole extent; the minor calyces disappear; the angle formed by the ureter at its entrance into the kidney pelvis becomes more acute; and the pelvis becomes more dilated. These are the changes of prime importance in the early diagnosis and they must be definitely defined in order to establish the differentiation of a large normal kidney pelvis from an early hydronephrosis. In some cases the determination of an abnormality necessitates a comparison of the two kidneys, as usually the two pelves will be of equal size in a normal case, while in a case of hydronephrosis only the

FIG. 6 A. Blood supply of kidney showing an extra blood supply to the lower pole.

FIG. 6 B. Normal blood supply of the kidney.

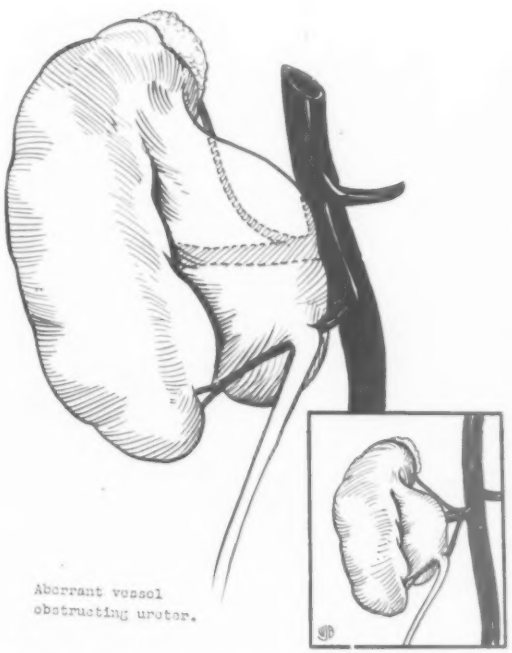


FIG. 6 C. Schematic drawing showing aberrant blood supply; in one instance the vessel is given off from the abdominal aorta and in the other from the renal artery.

FIG. 6 D. Removed kidney, with hydronephrosis resulting from an aberrant vessel.

FIG. 7 A. Kidney pelvis with no solution in upper calyx because of stricture of infundibulum.

FIG. 7 B. Localized hydronephrosis of upper calyx showing calculus in stricture.

FIG. 7 C. Localized hydronephrosis of upper calyx of right side due to obstruction from small stones in the calyx.

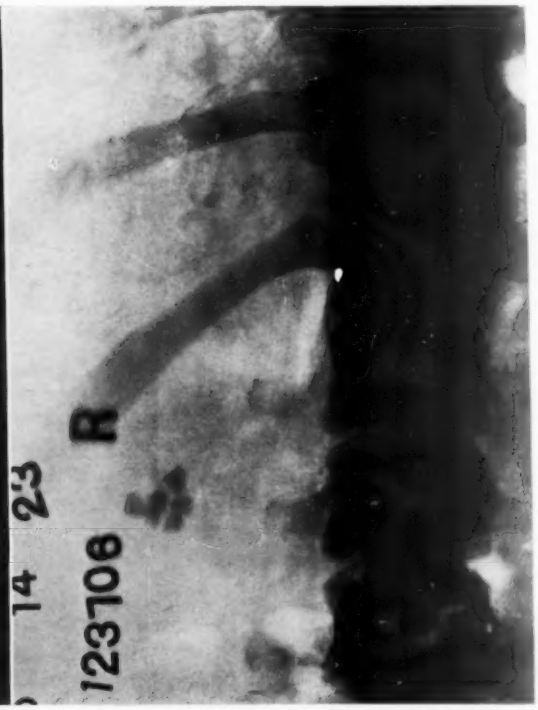


FIG. 7 D. Stones in C simulating gall-stones.

pelvis on the affected side will be enlarged. In an advanced case of hydronephrosis the diagnosis can usually be established by a cystoscopic examination with catheterization of the ureter, although often a pyelogram is necessary. In the advanced case the following changes will be noted: Extensive dilatation of the pelvis (Fig. 5 A and B); rounded individual areas and dim areas suggesting diluted fluid; the major calyces will not only have become broadened but they will be shortened until they may present only a shallow indenture into the smooth contour of the hydronephrotic sac.

SUMMARY

The important points in the establishment of the diagnosis of hydronephrosis may be briefly summarized as follows:

1. Familiarity with possible deviations in the normal kidney pelvis.
2. Determination of the probable etiology, if possible.
3. Employment of a technique which will produce films showing a sharp contrasting outline of the injected medium.
4. Assurance that the kidney pelvis is completely filled by continuing the injection until the patient experiences a sensation of pressure or pain in the region of the kidney.
5. Appearance in the pyelogram of the *definite* changes in the kidney pelvis and calyces which are characteristic of hydronephrosis.

DEEP ROENTGEN THERAPY OF NEOPLASTIC PULMONARY METASTASES*

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THE early and frequent invasion of the lungs by metastases of malignant neoplasms has been long known. There are three reasons for this frequency of pulmonary involvement, these being concerned with the anatomy of the chest. First, the intrathoracic structures are extremely rich in blood vessels; second, there is an abundance of lymphatic vessels leading to and within the thorax; third, there is a proximity of the organs which are the most favorable places for the development of malignancies, such as the mammary glands, the stomach, the liver and the pancreas.

We can easily comprehend why the lung tissue is the most favorable place for all metastases, since, first, the dissemination of metastases of sarcomata and the mixed organoid tumors, such as teratoma, deciduoma, hypernephroma, etc., is by way of the blood system; second, the dissemination of carcinomata is generally by lymphatic permeation; and third, neoplasms often spread by direct extension through contiguity of tissue.

It is of additional importance that when such metastases have once invaded the lungs, death must follow, because of the vital importance of these organs, and the fact that until the advent of radium and roentgen therapy, no method of treatment could afford even partial relief. With this as a stimulus, and with the added incentive of being able to observe closely the changes brought about by intensive irradiation of chest tumors, we have for the past two years pressed our studies in this direction. In this communication, we wish to present the results of our observations.

We shall confine ourselves in this paper entirely to malignant blastomata, sarcomata, carcinomata and the mixed organoid tumors. We shall deal in another paper with malignant tumors which also invade the lungs, such as, for example, Hodgkins' disease, leucosarcoma, etc., because we

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believe that here the chest findings are merely local manifestations of a constitutional disease. For the same reason, lymphosarcomata will be considered in this latter group, for a lymphosarcoma is not a pure metastasizing malignant tumor, but a condition the progress of which merely simulates the course of an infectious disease.

GENERAL PRINCIPLES OF TREATMENT

When treating malignancies of the lung, two very important principles have to be considered: First, it is essential that the necessary biological dosage of radiation should be administered to the tumor tissue itself; second, the normal lung tissue must be protected from all damaging changes as a result of the radiation. Unfortunately, the effects of the radiation on these two tissues are diametrically opposed. While the neoplastic tissues as a rule show a decreasing sensitiveness toward repeated radiation, the normal lung tissue itself shows increasing sensitiveness, especially after a certain limit of dosage has been exceeded. Thus we observe, when treating malignant growths of any part of the body, that following the first application, there is a very striking reduction in the size of the tumor, but when a recurrence appears or when it is necessary to give further treatments for the original mass, the reduction is less rapid and the recurrence is more refractory. On the other hand, when the normal lung tissue is repeatedly exposed to the action of deep roentgen rays, an increasing sensitiveness develops, causing changes which may result in permanent damage to the radiated lung. The complexity of our problem in bilateral pulmonary involvement is thus obvious.

Therefore, it becomes necessary to work out a technique which, while taking care entirely of the lesions themselves, will prevent the production of such secondary changes that are, as in their later stages, sufficient in themselves to cause death. This point will be taken up later in our paper.

1. *Treatment of Sarcomata.* We have no accurate figures, but various authors estimate the frequency of metastases of sarcomata as high as 85 per cent. The rich blood-vessel supply of these tumors, the repeated hemorrhages following necrosis within the tumor mass, and the tendency of sarcomatous cells to break through the walls of the veins of the adjacent tissues make the dissemination by blood vessels the most common route of extension. The embolic cells, once they have invaded the blood stream, are carried to the heart where they may be arrested, but more frequently are carried by the pulmonary circulation to the lungs where they regularly lodge in the parenchyma, thus producing the well-known picture of diffuse metastatic pulmonary sarcoma. The lungs have a filtrating effect on the blood stream, retaining, or at least endeavoring to retain, all of the emboli circulating in the blood. On the other hand, the tendency of the majority of sarcomata to grow upon the vascular framework explains why metastases are formed in the earlier stages of the disease and why the radical removal of the primary lesion is in most cases of only palliative value.

Among our treated cases of sarcomatous metastases to the lungs, were those which had had previous surgical treatment for the primary lesion, and also those which, on account of the advanced stage of the disease, had had irradiation only, both to the primary and secondary lesions. The variation in the results obtained would lead to the conclusion that there is a definite selective reaction of the different sarcomatous groups toward irradiation. For instance, while a metastatic angiosarcoma of the lungs may quite disappear in from three to six weeks following the treatment, metastases of periosteal sarcomata are apparently entirely refractory to irradiation, even in the earliest stages, at least to the dosage which we have used.

The other sarcomatous groups occupy an intermediate position, some of them clearing up following the first series and others apparently needing repetition of the treatment, which, as we shall see, is often impossible because of the marked lung changes incident to the heavy radiation.

These variations in the response of the different sarcomatous groups to radiation

show plainly that the structure of these tumors is of extreme importance. However, the morphological structure of sarcomata, —the spindle-celled, round-celled and giant-celled groups—is not the only determining factor in their susceptibility to irradiation.

We have seen, for example, a spindle-celled sarcoma originating from the broad ligament, with wide-spread metastases, clear up entirely under roentgen treatment, and this patient is now, almost one year after the treatment, in good health; and Figures 7–9 show the good results obtained in two such cases of metastatic angiosarcoma of the lungs. In the first case, the primary lesion was in the iliac bone (Fig. 1). This was successfully treated by deep roentgen therapy eighteen months ago (Fig. 2), but six months later metastases developed in the lungs (Fig. 3) although there was no evidence of a local recurrence. Appropriate treatment was given for the pulmonary involvement and three weeks after the treatment the lungs had become entirely clear (Fig. 4). Immediately follow-

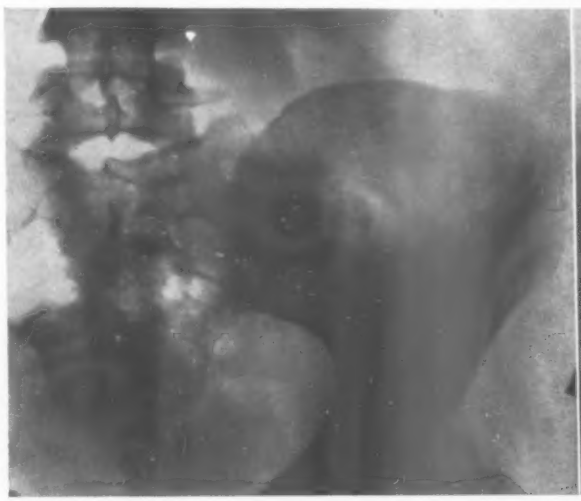

FIG. 1. Primary angiosarcoma of the iliac bone, with considerable destruction of the bony structures.

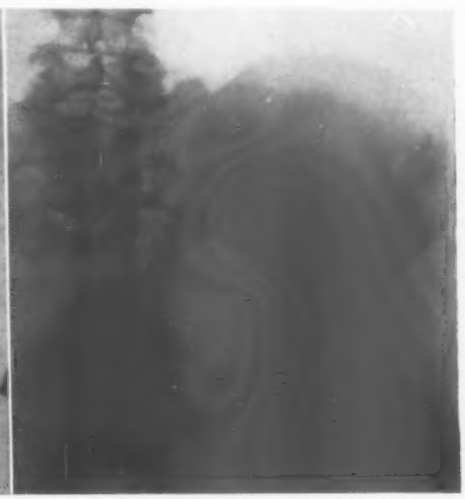

FIG. 2. Same case as in Figure 1, one and a half years after deep roentgen treatment. There is a complete reorganization of the bony structure. No local recurrence for one and a half years.

while a spindle-celled sarcoma, originating from the periosteum of the lower end of the femur and which had produced lung metastases (Figs. 10 and 12) showed not the least response to irradiation. Indeed, it seems that the histogenetic structure plays a still more important part in the radiosensibility of sarcomata than the morphological structure.

Angiosarcomata are tumors of the extreme embryonal type, being rich in vascular tissue and apparently free of paraplastic structures, with the cells highly undifferentiated. They are rich in chromatic nuclear substances and show abnormal morphology. This type of cell is especially susceptible to irradiation. Figures 1 to 6 ing the treatment there was an improvement in the patient's general condition, and she early returned to normal, in which condition she has remained (Figs. 5 and 6). In the second case, the primary lesion was on the thigh, and when deep roentgenotherapy was instituted, the patient already had advanced metastases in the lungs (Fig. 7) and his condition was rapidly deteriorating. Three weeks following the treatment, there was a marked improvement in his condition, but the metastases had not entirely disappeared (Fig. 8). Six weeks following the first application of deep roentgen ray a second series was given, limited to the roots of the lungs. Following this treatment, all metastases

disappeared (Fig. 9) and the primary lesion also is almost healed, with the patient's general condition good.

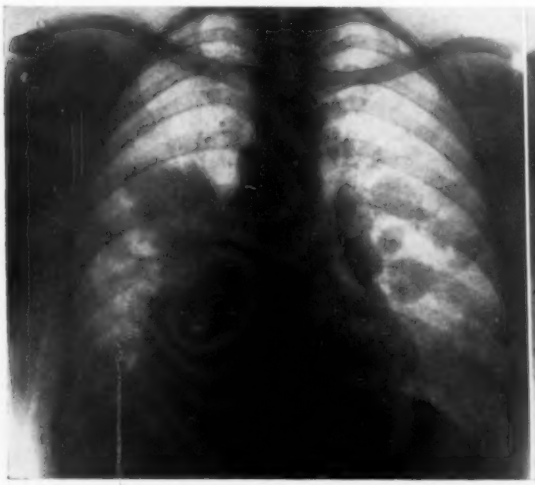

FIG. 3. Same case as in Figure 1, six months after the treatment of the primary lesion. Extensive metastases developed in the lungs.

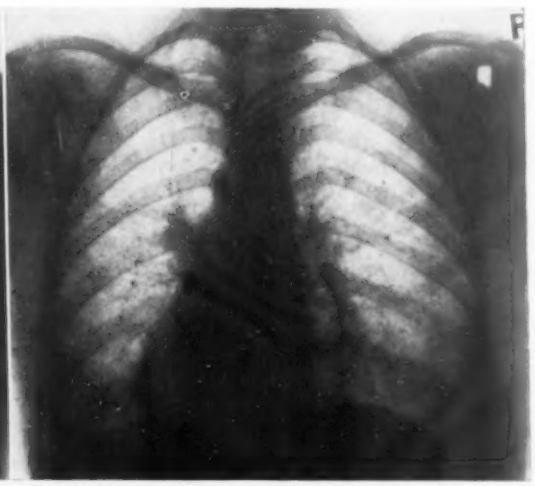

FIG. 4. Same case as in Figure 3. Three weeks after the treatment of the secondaries, the lung fields have entirely cleared up. No evidence as yet of infiltration of the normal lung tissue due to the effect of radiation.

Periosteal sarcomata metastasizing to the lungs are usually of the spindle-celled type. These tumors, in contrast to the angiosarcomata, are tumors of adult fibroblastic nature. The cells are spindle-shaped, small and highly differentiated, and there may be a rich intercellular substance (for instance, fibrous or osteoid). These tumors show a low susceptibility toward irradiation, and the results, even in the early stages, using the present technique are unsatisfactory. Figure 10 shows beginning lung metastases of a spindle-celled periosteal sarcoma of the lower end of the femur. The primary lesion had been treated

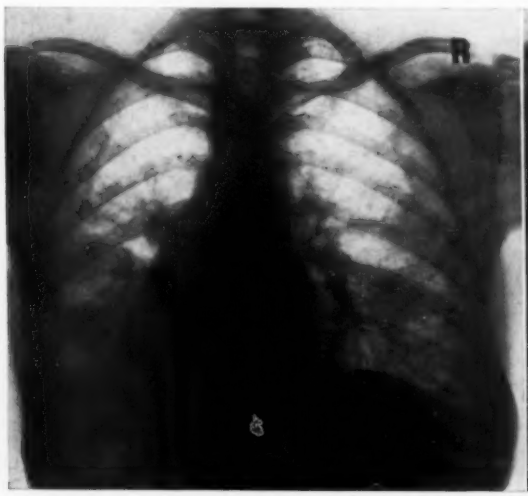

FIG. 5. Same case as in Figure 3, six months later. No recurrence of the secondaries in the lungs. However, at this time there is an infiltration around the roots of the lungs, typical of central pneumonia, which is due to the effect of the radiation on the normal lung tissue.

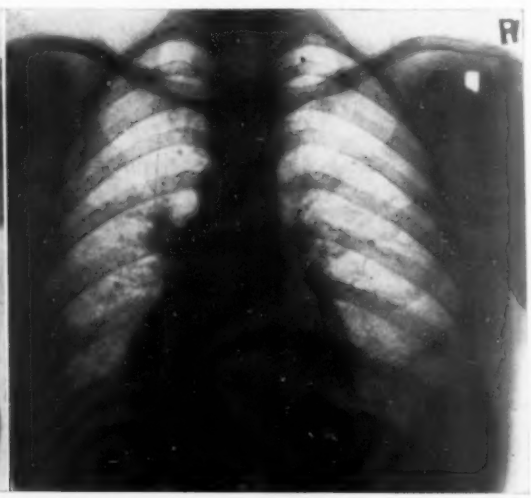

FIG. 6. Same case as in Figure 3, one year later. The infiltration of the lungs has disappeared. At this time the lung fields show practically normal appearance. There is only slight accentuation of the hilus shadow.

by irradiation, which was followed by amputation of the leg, but shortly after the operation lung metastases had appeared. Deep roentgen treatments were given for

FIG. 7. Metastatic angiosarcoma of the lungs. Primary lesion in the thigh.

FIG. 8. Same case as in Figure 7. Six weeks after deep roentgen-ray treatment was applied to the secondaries as well as to the primary lesion. Most of the nodules have disappeared. Only a few nodules left around the hilus. The primary lesion is reduced to half its original size. At this time treatment was repeated for both the primary and the secondaries. The treatment of the lungs included only the parts around the hilus.

these lesions, using the same technique as in the above-mentioned angiosarcomata, but in spite of the treatment the metastases continued to spread (Figs. 11 and 12) and the patient died three months later.

The other sarcomatous types metastasizing to the lungs occupy an intermediate position between the two types described. The nearer they come to the undifferentiated embryonal type, the better the results from the treatment, and the nearer they are to the adult tumors, rich in parablastic structures, the less the chance for successful treatment.

2. *Treatment of Carcinomata.* Since the usual method of extension of carcinomata is dissemination by way of the lymph vessels or extension by direct contiguity, it is evident that metastatic carcinomata of the lungs are secondary to neoplasms originating in the organs in proximity to the chest, most frequently the mammary glands, and less frequently the stomach, pancreas, liver and thyroid.

Usually three types of metastases are described:

(*a*) Circumscribed mediastinal metastasis. This usually appears in the posterior mediastinum in the form of nodules of different sizes, similar to the nodules in the

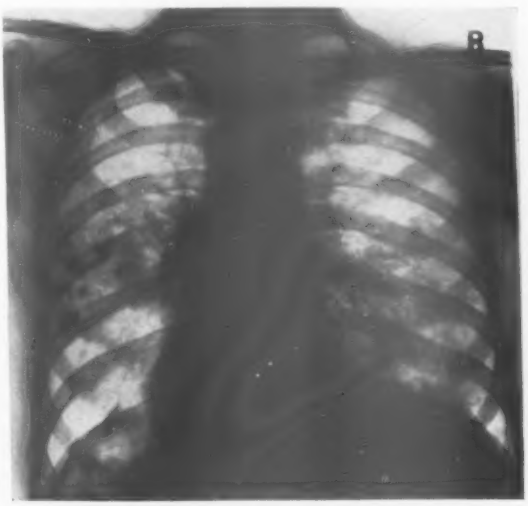

FIG. 9. Same case as in Figure 7, six weeks after the second application of radiation. All the nodules have disappeared, but at this time there is infiltration of the lungs, similar to that described in Figure 5, no doubt due to the effect of the radiation on the normal lung tissue. Primary lesion almost healed.

breast, when the dissemination occurs by way of the pectoral lymphatic plexus

axillary glands. Nodular metastases involving the anterior mediastinum are less frequent, occurring usually secondarily to malignancy of the thyroid gland or the

and the perforating branches running to the mediastinum. In our case (Fig. 13) the primary lesion was a carcinoma simplex of the breast, successfully removed by a radical operation. Eight years later the patient developed metastases in the anterior mediastinum. This was treated by deep roentgen rays and in six weeks the mass had entirely disappeared (Fig. 14). The patient is now symptom-free.

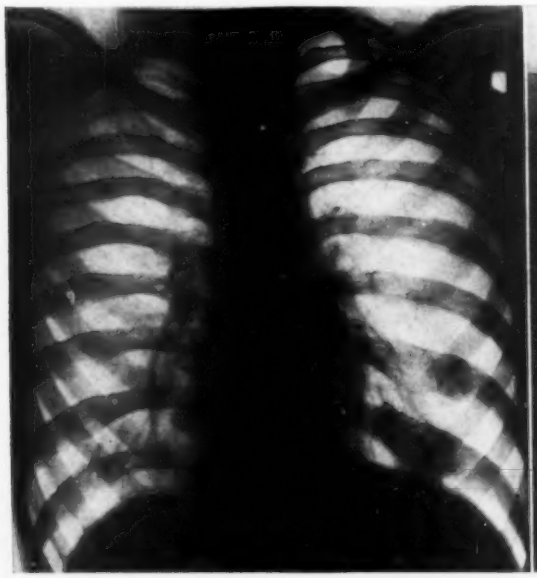

FIG. 10. Beginning metastasis of the lung (right lower lobe) after primary spindle-celled, periosteal sarcoma of the lower end of the femur. Preoperative radiation of the primary lesion and later amputation of the leg were performed.

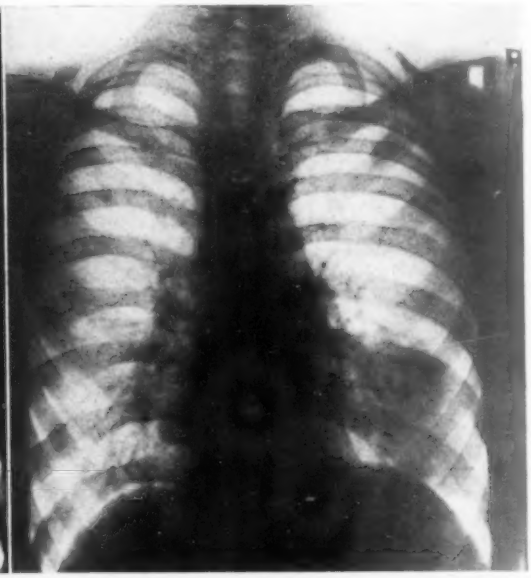

FIG. 11. Same case as in Figure 10, six weeks later. In spite of the treatment, lesion is continuing to spread.

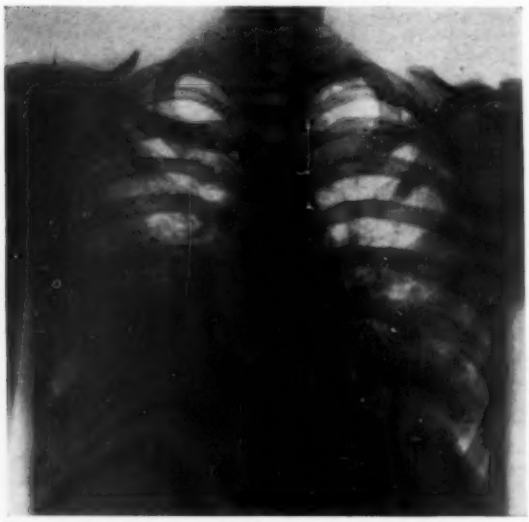

FIG. 12. Same case as in Figure 10, ten weeks after the treatment. The lesion is rapidly spreading. Patient died three months after treatment.

(*b*) Infiltrating lymphangetic metastasis. This form of metastasis usually produces a broadened mediastinal shadow, from which the carcinoma spreads in the form of thick-walled, shadowy structures outward and upward, with a shading off of the process in the normal lung tissue. At the periphery there is a radiating appearance of the process, because the carcinoma infiltrates the lung tissue, especially along the bronchial tree. A typical picture of such an infiltrating lymphangetic metastasis is shown in Figure 15. The primary lesion in this case was a carcinoma simplex of the breast. About three months after the treatment, one single dose having been applied, the lesion had entirely disappeared (Fig. 16) and the plate taken almost one year later (Fig. 17) still shows, except for slight fibrotic changes, the lung fields to be entirely clear. The patient is now free of untoward symptoms.

(*c*) Miliary metastasis. This form of metastasis is not so rare as was thought a few years ago. Systematic roentgenographic examinations of the chest in all cases of carcinoma result frequently in the demon-

stration of discrete areas of involvement of the lung parenchyma. Apparently these lesions are not productive of symptoms, but they are of extreme importance from the standpoint of treatment of the patient. At times the differential diagnosis between this type of lung malignancy and chronic submiliary tuberculosis is extremely difficult. We have treated several cases showing this type of lesion and the response to the treatment was satisfactory. We held that the prompt disappearance of the nodules after treatment verified the diagnosis of carcinomatosis and ruled against tuberculosis. In spite of the local improvement, these cases have a grave prognosis on account of the generalization of the lesion in the remainder of the body. At best, the improvement is only temporary, and probably life is prolonged but a few months. Figure 18 illustrates such a case. Six months following the roentgen treatment the lesions had practically disappeared (Fig. 19), but in the meantime the patient developed metastases to the liver, omentum and brain, and died eight months following the treatment. In these cases the metastases no doubt occur by way of the blood stream to every part of the body.

A fourth form of metastasis of carcinoma of the chest may be mentioned, that of localized involvement of the pleura by direct extension. Figure 20 illustrates such a case. The primary mass in the breast was removed by a radical operation. About two years later the patient developed metastases to the liver and omentum, accompanied by ascites. At this time, two metastatic nodules could be detected in the posterior pleural wall. The patient received a course of irradiation and there was a striking improvement in her condition (Fig. 21). The ascites disappeared, the liver went down to almost normal size, and the metastatic nodules in the pleura disappeared.

3. *Treatment of Mixed Organoid Tumors.* Our work in this connection is incomplete, but, judging from the good results obtained in treating these lesions in other parts of the body and the close relationship of these tumors to sarcomata, there is sufficient justification for treatment of this tumor group by irradiation.

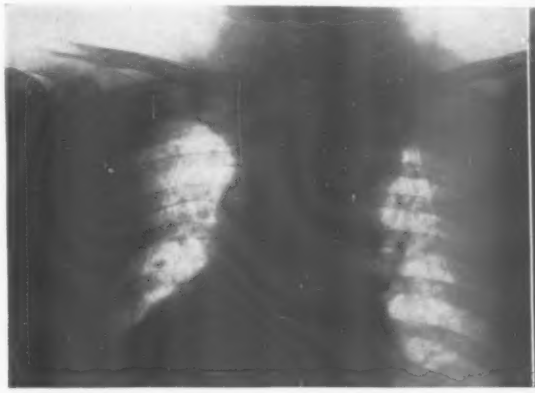

FIG. 13. Circumscribed metastatic tumor in the anterior mediastinum after primary carcinoma simplex of the breast, radically removed eight years ago. No evidence of local recurrence.

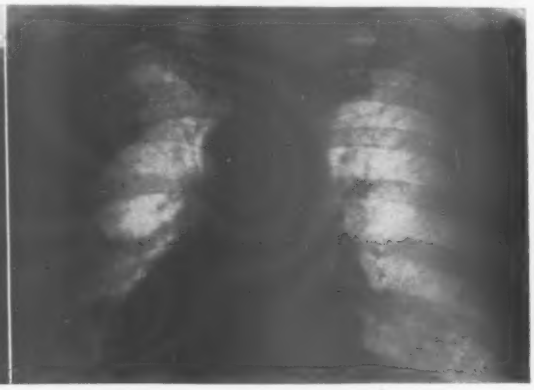

FIG. 14. Same case as in Figure 13, six weeks later. The tumor mass has entirely disappeared.

COMPLICATIONS DUE TO THE EFFECT OF RADIATION ON THE PATHOLOGICAL AND NORMAL TISSUE OF THE LUNGS

There is voluminous literature by distinguished authors dealing with the effect of radiation on pathological tissues. It is, therefore, not our intention to discuss this subject here, for the effect of radiation on the pathological tissues of the lung is the same as anywhere else in the body; but we should like to consider the complications which may arise from such action on the tumor masses located in such a delicate and specialized structure as that of the lung.

1. *Hemorrhage of the Lung.* When deep, bulky tumors of the lung are subjected to intensive irradiation, extensive necrosis may be produced within the tumor mass, and in vascular growths such a necrosis may lead to a profuse hemorrhage, which is often fatal. One of our patients treated for a bulky carcinoma of the upper lobe of the left lung died three weeks following the treatment as the result of such a hemorrhage. The autopsy showed that practically all the tumor tissue was transformed into a necrotic mass; but few tumor cells remained, and these showed signs of hydropic degeneration (Fig. 22). Fortunately, this accident does not occur very often, because the defense system of the body has another way of fighting such radical changes. As a reaction to the degeneration which begins within the tumor mass, the organism develops an inflammatory process with fibroblastic proliferation around the tumor. A fibrotic capsule is developed which has a tendency to cut off entirely the tumor mass from its blood supply (Fig. 23). Later fibrotic bands penetrate within the tumor substance and simply strangulate the cells (Fig. 24) until the whole tumor is replaced by connective tissue. We made microscopic sections of a healed sarcomatous nodule of the lung of a patient who later died as a result of generalized metastases, and found that the entire nodule was transformed into dense, fibrotic tissue (Fig. 25); a few cells were left encapsulated within it.

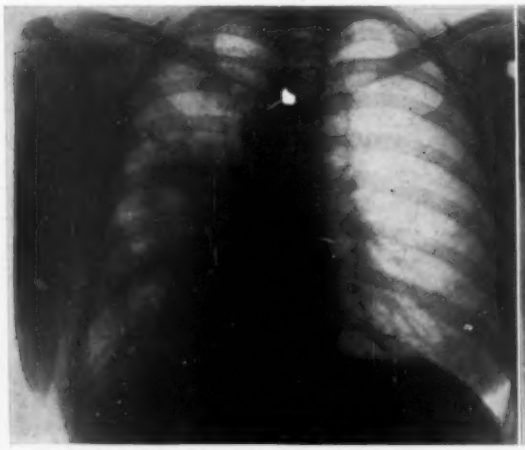

FIG. 15. Infiltrating, lymphangetic metastasis from carcinoma simplex of the breast.

FIG. 16. Same case as in Figure 15, three months later. Lesion has practically disappeared.

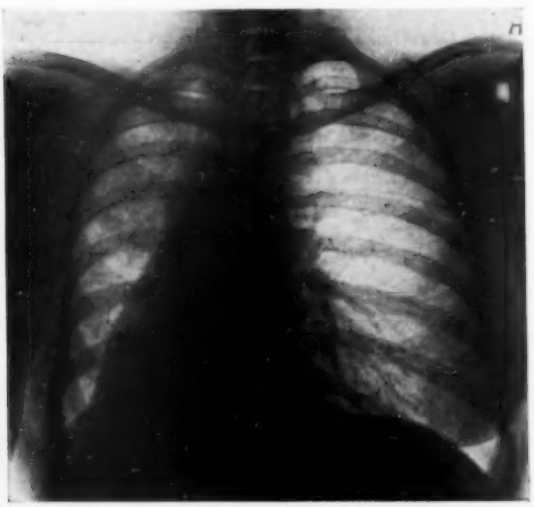

FIG. 17. Same case as in Figure 15, one year later. The lung fields, except for slight fibrotic changes, are clear.

2. *Rupture of the Lung.* This has the same origin as hemorrhage. The necrosis of a tumor nodule may lead to an open communication between the air cells, or bronchi, and the pleural cavity, and pneumothorax may develop (Fig. 26). Previous to the treatment there was a spontaneous pneumothorax on the right side which was probably caused by rupture of the lung due to the rapidly growing metastatic nodules; following the treatment, however, the pneumothorax on this side had cleared up and a pneumothorax

had developed on the opposite side (Figs. 27 and 28). The patient died later as a consequence of generalized metastases and the autopsy showed that the lung which was collapsed previous to the treatment was adherent to the chest wall, while the opposite lung was entirely atelectatic.

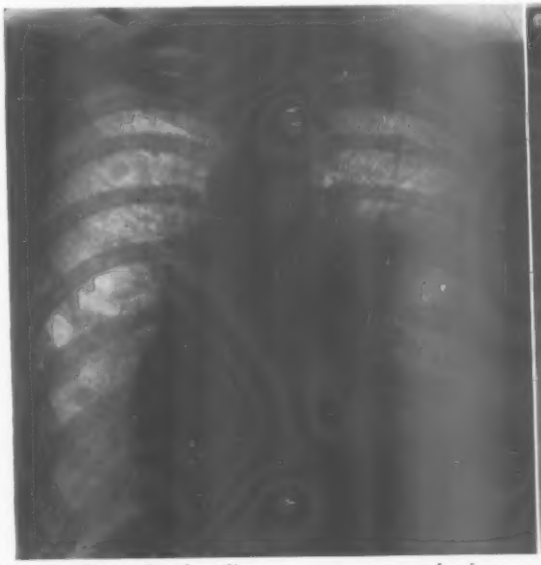

FIG. 18. Generalized miliary metastases to the lungs after primary carcinoma of the breast, radically removed two years ago.

FIG. 19. Same case as in Figure 18, six months after radiation. The lung fields have practically cleared up. There is only fibrosis at the roots of the lungs; but owing to the considerable enlargement of the liver, followed by generalization of the metastases, the right leaf of the diaphragm is pushed up. Patient died two months later.

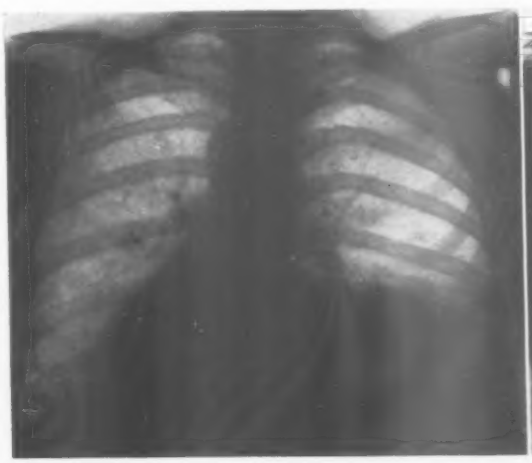

FIG. 20. Pleural metastases after primary carcinoma of the breast, radically removed about two years ago. Enormous enlargement of the liver with pushing up of the right leaf of the diaphragm; omental involvement with accompanying ascites, and two noduli in the posterior pleural wall.

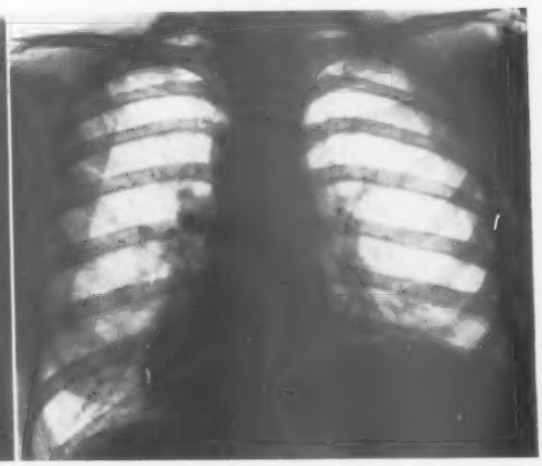

FIG. 21. Same as in Figure 20, about six months later. Liver has diminished in size; the ascites has been absorbed; and the metastatic noduli on the pleura have disappeared.

3. *Changes in the Normal Lung Tissue.* Far more important is the question as to whether or not heavy radiation of the lungs, such as is necessary for the treatment of sarcoma or carcinoma, will produce changes in the normal lung tissue which may lead to an impaired function of this vital organ. We subjected this question

FIG. 22. Bulky carcinoma of the upper lobe of the left lung, destroyed by radiation. Practically all the tumor tissue is transformed into a necrotic mass. There are only a few cells left as an isolated island. There is hydropic degeneration of the remaining cells.

FIG. 23. Fibroblastic proliferation and formation of a fibrotic capsule around a tumor nodule treated by radiation. The tumor cells themselves are undergoing degeneration and in places there is marked, small, round-cell infiltration. The surrounding fibrotic tissue tries to encapsulate entirely the tumor nodule.

FIG. 24. Advanced fibrotic changes around an encapsulated, and in its greater part already destroyed, tumor nodule. Thick, fibrotic bands penetrate within the tumor mass and simply strangulate the cells.

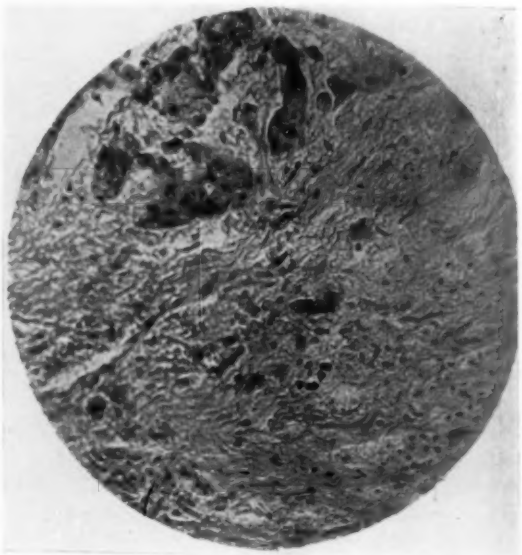

FIG. 25. The whole tumor mass is replaced by dense connective tissue. This is the end-result of a practically healed nodule. However, in many cases, as shown in this figure, cell islands are left within the scar tissue which maintain their vitality for long periods.

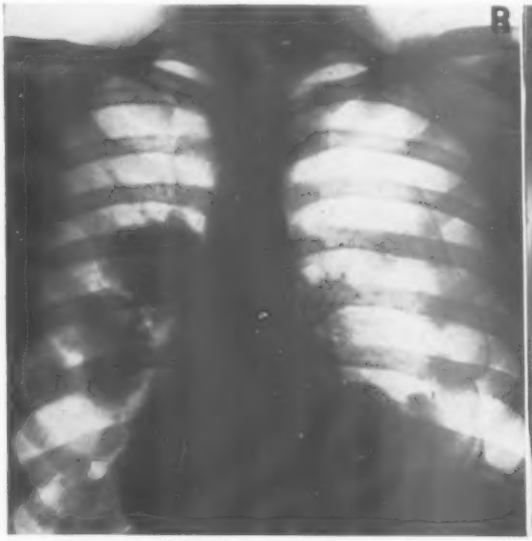

FIG. 26. Advanced sarcomatous metastases to the lungs after primary angiosarcoma of the pelvic bone. Rupture of the right lung with following pneumothorax: partial collapse of all three lobes of the right lung.

FIG. 27. Same as in Figure 26, six weeks after deep roentgen-ray treatment of the lungs. Most of the noduli have disappeared. The pneumothorax on the right side has cleared up but there is now a total collapse of the left lung.

to a thorough study and found that certain practical conclusions could be drawn. In another paper we shall expound in detail the results of this study. Here we should like to mention only the conclusions at which we arrived.

If a dose less than 60 to 70 per cent S. E. D. is administered over the entire lung fields, no changes whatever will occur in the lungs, but as soon as this dose is exceeded a *locus minoris resistentiae* is created, this not differing from that created in the lungs by other pathological conditions, as, for example, resolved lobar pneumonia. But, if an overdose or repeated high biologic doses are administered over the lungs, then certain changes occur. These are of two different types: (*a*) Early changes manifesting themselves as an *infiltration of the lungs* and (*b*) late changes appearing as *fibrosis of the lungs*.

(*a*) *Infiltration of the Lungs.* If a dose of 100 per cent S. E. D. is exceeded or if a dose less than 100 per cent S. E. D. is given over a *locus minoris resistentiae* of the lungs (this having been produced

FIG. 28. Same as in Figure 26, ten weeks after treatment. The left lung is pushed almost entirely over to the right side as a result of the very extensive pneumothorax. Two weeks later, patient expired as a result of general metastases.

by either previous roentgen-ray exposures not exceeding 100 per cent S. E. D. or by previous pathological conditions, such as lobar pneumonia, etc.), then characteristic changes develop. Figures 5 and 9 show the roentgenographic appearance of such changes. These changes usually start at the hilus like a central pneumonia, producing irregular, hazy, washed-out shadows around the roots of the lungs, which sometimes progress toward the lung parenchyma, but in the majority of cases remain localized to the hilus. Accompanying these changes, there is often a thickening of the pleura and the interlobar septa. The histological appearance of such a condition is shown in Figures 29 and 30; that is, marked thickening of the alveolar walls, and, secondary to this, compression with resulting diminution of the air spaces; desquamation of the epithelial cells; coagulum formation filling out the lumen of the air spaces (edema); and leucocytic infiltration of the septa. These are the most important features of such an infiltrative condition. At the same time there is marked reaction on the part of the pleura (Fig. 29). In the majority of cases this condition is absolutely harmless, and during the following two to six months a total resorption may follow and the lungs regain their normal appearance (Fig. 6).

FIG. 29. Histological section of an area of the lung and pleura, showing infiltration due to the effect of the radiation. Most of the air spaces are filled with coagulum (edema) and desquamated epithelial cells. There is a small round-cell infiltration of the pleura.

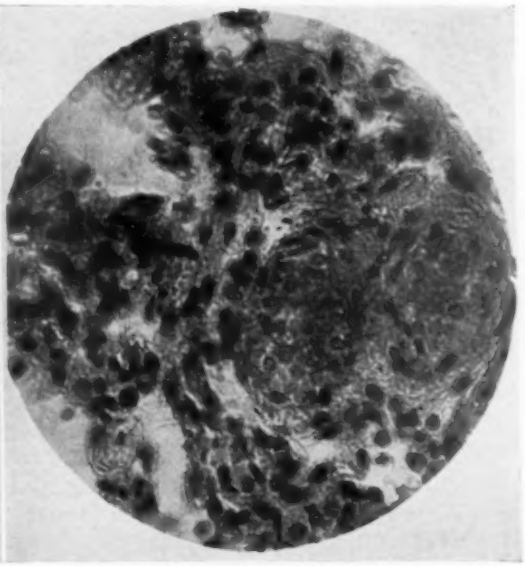

FIG. 30. Same as in Figure 29. High power. There is marked thickening of the alveolar walls. The air cells themselves are filled with desquamated epithelial cells and coagulum granuli. There is a leucocytic infiltration of the septa.

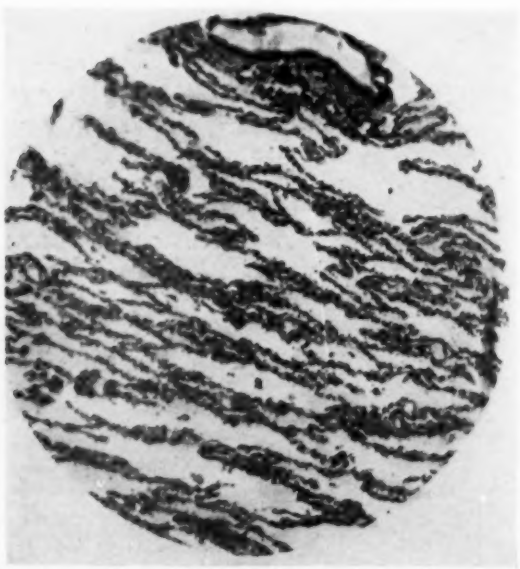

FIG. 31. Beginning fibrosis of the lung parenchyma, due to the effect of radiation. The leucocytic infiltration is replaced by fibroblastic proliferation. There is a diminution in the lumen of the air spaces, as a result of the compression by the proliferation.

FIG. 32. A more advanced stage of fibrosis of the lung parenchyma, due to the effect of radiation. Most of the air spaces are entirely obliterated. The rest of them are compressed by the rapidly proliferating, connective tissue. There is marked hyperplasia of the perivascular connective tissue.

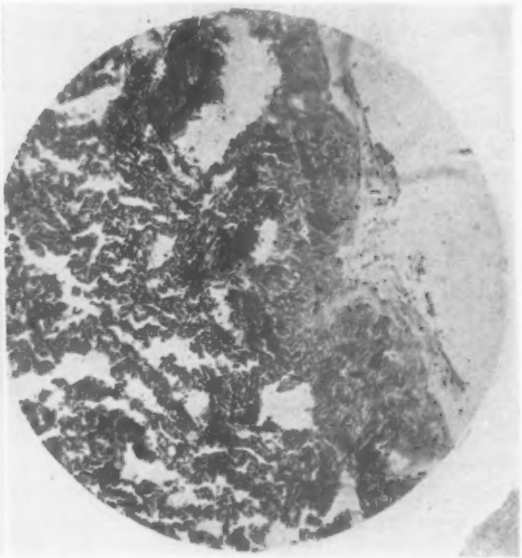

FIG. 33. Same as in Figure 32, but showing fibrotic changes at the periphery of the lung. There is formation of extensive fibrotic layers in the pleura. These layers grow toward the lung tissue, penetrating along the septa.

(*b*) *Fibrosis of the Lungs.* When a 130 per cent S. E. D. is exceeded or repeated (three or four heavy radiations given over the same area) entirely different conditions arise. In the majority of cases severe changes occur, similar to the induration of the skin after repeated deep roentgen-ray exposures (leather skin), due to vascular injury and fibrotic changes. The leucocytic infiltration is replaced by fibroblastic proliferation; this in turn leads to compression (Fig. 31), and later to total obliteration of the air cells (Fig. 32). In addition to this, there is marked hyperplasia of the perivascular connective tissue, and the pleura shows extensive formation of new fibrotic layers (Fig. 33) which grow toward the lung tissue, penetrating along the septa and separating the secondary lobules. Still later, the whole lung tissue may be transformed into a dense, connective tissue with complete destruction of the alveoli (Fig. 34). In such a histological section, only the presence of coal particles reminds us that

FIG. 34. Very extensive fibrosis of the lung. Practically the whole lung is replaced by a dense connective tissue. There is complete destruction of the lung parenchyma. Only the presence of coal particles reminds us that the tissue is that of an entirely destroyed lung tissue.

we have to do with an entirely destroyed lung tissue. The roentgenographic appearance of such an advanced fibrosis is identical with that encountered in other pathological conditions, especially fibrosis after pneumonia. Indeed, there is a striking similarity between these two processes. Thus, it is generally known that in individuals whose resistance is lowered and especially where there is a tendency toward inflammation of the lungs (locus minoris resistentiae), a fibroblastic invasion may follow a croupous pneumonia rather than a leucocytic invasion, and if such a patient develops two or three subsequent attacks of croupous pneumonia (probably because of the locus minoris resistentiae) extensive fibrosis of the lungs follows, absolutely identical with the condition described above.

TECHNIQUE

Local Treatment. When treating malignant metastases of the lungs, it is necessary to use a technique that will destroy the tumor tissues, and yet not damage the normal lung tissues. It is extremely difficult, if not impossible, to calculate exactly a physical dose (estimated in the water-phantom) which would fulfill these conditions, for the absorptive conditions in lungs involved by metastatic tumors are so complex that no exact conclusions can be drawn regarding the measurements. The normal lung contains air and consequently its permeability is higher than that of other tissues. By using the absorption charts as applied for the remainder of the body, an overdosage will be given which in turn, as shown above, will result in permanent damage to the lung tissue. On the other hand, if the lung tissue is filled with scattered metastatic tumor masses, its permeability toward radiation is decreased, and by using the absorption charts as arranged for the normal lung tissue, the tumor masses will be underdosed. Furthermore, considering that repetition of the treatment is liable to produce severe changes in the normal lung tissue, it is extremely important that the dose necessary to the tumor mass should be given in a single series. From our experience in the treatment of malignant tumors in other parts of the body, we do not believe that a standard so-called lethal sarcoma or carcinoma dose exists—we can speak only of optimum doses, which have to be repeated at due intervals. On the other hand, in treating lesions of the lungs, we had to attempt to give the maximum physical dose possible in a single series in order to avoid repetition of the treatment. This being the case, we did not try to estimate a standard biological dose for each tumor growth, but merely administered a physical dose which would be tolerated by the normal lung tissue, without producing secondary changes. This dose was estimated at 90 to 100 per cent S. E. D., as measured in the water-phantom. For the normal lung tissue this may reach from 120 to 130 per cent S. E. D., but for lungs infiltrated by the metastatic masses, the effective dose will be somewhere between 100 and 130 per cent S. E. D. We project this dose into the lesion as a non-concentrated massive dose, i.e., in contrast to the massive dose concentrated in one sitting (even for ten to twenty hours' uninterrupted exposure), we prefer to spread the administration of the dose over several days giving only four to six hours' exposure each day, which gives the patient ample time to recover from the effect of each individual treatment. However, we never spread the administration of the treatments over a period of more than a week. We cross-fire the lesion from different directions. Because of the higher absorption coefficient of the mediastinum and of the hilus, as compared with that of the lung parenchyma, we usually like to rotate the patients 45°, using large portals of entry from the front and back for each lung and if necessary, from the side. In this way, if the periphery of the lungs is cross-fired, for example, from two portals of entry, the mediastinum and the hilus, owing to the angulation, will be cross-fired from four portals of entry, and a sufficient dose will be administered to these tissues. By using this technique, we were able in the majority of cases to eradicate completely the lesion in a single course, and at the same time to protect the normal lung tissue from any serious damage. Indeed, the majority of our

patients, successfully treated, were able to resume their work shortly after the treatment without showing any respiratory disturbances. Only in a few cases was it necessary to repeat the treatment.

The factors used in the treatment are as follows: 200,000 volts (peak) with 1.3 mm. Cu. and 1 mm. Al. as filters; S. T. D. varying from 40 to 60 cm.—large portals of entry. The effective wave-length of the rays produced under these conditions was λ eff. = 0.137 Å. u.

2. *General Treatment.* It is now generally recognized that in addition to the local effect of the roentgen rays upon the tumor mass, there is also a general effect from the reacting defense system of the body. Whether this is purely an antitoxic effect or whether it is a blood reaction as manifested by phagocytosis, we do not yet know. Recent experiments on animals by different authors undoubtedly prove that a tumor immunity exists. Until this question is put on a more solid basis, we have to explain the effects upon the broad general ground of stimulation of the protective forces of the organism. Stimulating irradiation of the spleen at repeated intervals, hypodermoclyses of saline solution following treatments, intravenous injection of electroferrol in the postradiative period, prolonged use of iron and arsenic preparations, are now indispensable parts of successful deep roentgen treatment.

PROGNOSIS

Our observations are limited to a period of one and one-half years. Consequently, no statement can be made regarding the final outcome of these diseases. Up to the present time, it was generally accepted that after a sarcoma or any other malignant tumor had metastasized to the lungs, the metastases were already spread to other parts of the body, so that even if the lung metastases were arrested, the patient would die as a consequence of the other metastases. Indeed, it has frequently been demonstrated that single cells of certain sarcomatous types are able to pass through the pulmonary capillaries into the general blood circulation and thus produce a generalization of the metastatic process in the whole body. Notwithstanding these facts, several of our patients, after successful treatment of the primary lesion and of the metastatic process in the lungs, have returned to normal health and have shown, up to the present time, a period of over a year, no signs of other metastases. This certainly is an accomplishment never expected before. We do not know anything about sarcoma or carcinoma immunity; consequently, we would not attempt to submit any theoretical explanations, but it is possible that the breaking down of the tumor cells by heavy irradiation may produce sufficient antibodies to enable the protective forces of the organism to take care of the few embolic cells left in the blood circulation or already spread to other organs of the body, and thus completely and permanently eradicate the disease. It is interesting to note, in this connection, that none of our seven cases of lymphosarcomata treated by an heroic irradiation of the whole lymphatic system has shown any signs of recurrence or of further metastases over a period of one to one-and-one-half years, although at the time of the treatment there was, in the majority of the cases, a very extensive involvement of practically all the lymphatic glands. We are convinced that we have in our hands a new weapon which the future will teach us how to use.

SUMMARY

1. Deep roentgen therapy is indicated in all metastatic malignancies of the chest where there are no metastases to be demonstrated in the remainder of the body.

2. While the tumor tissues as a rule show a decreasing sensitiveness toward repeated irradiation, the normal lung tissue itself shows an increasing sensitiveness.

3. In the treatment of metastatic sarcomata, the morphological and the histogenetic structure of the tumor play a very important part. Best results are obtained in the embryonal type of sarcomatas (angiosarcomata) while the fibroblastic, adult type of tumors, especially when rich in paraplastic structures, are refractory to radiation. The nearer the sarcomata come to the undifferentiated embryonal type, the better the chance for success, and the nearer they are to the adult

tumors, rich in paraplastic structure, the less the chance for success.

4. In the treatment of metastatic carcinomata, the circumscribed mediastinal metastases and the infiltrating lymphangetic metastases respond well to treatment, especially when the primary carcinoma is of the differentiated type. The miliary metastases of the carcinomata, if localized, respond well to the treatment, but if they are generalized, the prognosis is very grave.

5. Complications may arise incident to the treatment of all metastatic processes of the lungs: (*a*) hemorrhage of the lungs; (*b*) rupture of the lung, with following pneumothorax; (*c*) changes in the normal lung tissue.

6. If the dosage is not exceeded or if there is only one exposure, the lung changes are of only temporary character, that is, infiltration of the lungs; but, if the dosage is exceeded, and the irradiation is several times repeated, the changes may be permanent fibrosis of the lungs.

7. When treating malignant metastases of the lungs, the necessary biological dosage of radiation should be administered to the tumor tissue itself, but, at the same time, the normal lung tissue should be protected from all damaging results from the radiation. Therefore, attempt should be made to eradicate the disease in one single treatment. Only if this is impossible should the treatment be repeated. Never should a third or fourth irradiation be applied to both lung fields.

8. General stimulation of the protective forces of the organism should be an indispensable part of deep roentgen treatment.

9. No statement can be made regarding the final outcome of these diseases, our observations being limited to a period of one and one-half years.

10. The question of a sarcoma or carcinoma immunity is seriously to be considered. The future application of deep roentgenotherapy will probably develop along these lines.

NOTE.—We are indebted to Dr. P. F. Morse, Chief Pathologist for Harper Hospital and Dr. C. W. Halliday, of the Surgical Staff, for autopsy and pathological assistance.

HIGH-VOLTAGE TREATMENT IN A SERIES OF SARCOMA CASES*

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MEMPHIS, TENNESSEE

IN THE field of deep therapy today we occupy a position not entirely unlike that held in the field of superficial therapy some fifteen years ago. At that time we knew that we had come into possession of a most remarkable therapeutic agent, an agent which at times produced results little short of marvelous. By its use many diseases and conditions formerly thought to be hopeless were brought into the classification of "probably curable." There was at that time the greatest possible variation in the matter of technique. Hardly any two men were doing the same thing in the same way. All knew a good method of application, but none knew the best method.

And so today those of us who have had a considerable experience in the newer deep therapy are fully convinced that we have a method of application of radiant energy which is far superior to the older method, and that this method will give results that formerly were not obtained. In general, most of us are pleased with results that can be gotten. Some of us have seen a few cases resulting in cures beyond the wildest dreams of optimism. All of us have seen failures. All of us have seen cases that we thought would do well, but that did poorly enough; and those we thought hopeless we have seen recover.

Tumors that look alike to the unaided eye and to the microscope do not always react alike to a given method of treatment. There is still much to be desired in the matter of case classification and prognosis.

Our instruments of measurement have reached today a high degree of precision, and there is a far greater degree of unanim-

* Read at the Twenty-fourth Annual Meeting of THE AMERICAN ROENTGEN RAY SOCIETY, Chicago, Ill., Sept. 18–21, 1923.

ity of opinion in matters of technique than ever before, but there is yet much to be agreed upon.

It is easy to determine the dosage a given case *has* received, but it is difficult to determine the dosage it *should have received*. Some of us who readily take to rule-of-thumb methods believe that there is such a thing as a "carcinoma dose," but most of us doubt it. Some of us believe that the whole dose, whatever we determine that to be, should be given at one time; others believe that this total amount should be split up into daily doses of about one hour each. Some believe that all that can be accomplished is accomplished at the first treatment, or series of treatments, while others hold that the initial amount may be repeated several times with benefit, or hope of benefit. Again, some say that the initial amount may be repeated within a month, while others maintain that the dose should not be repeated until the lapse of two, three, four or even six months.

In view of these existing differences of opinion I think that some good may be derived from reporting cases, or series of cases, treated by a given technique, however far that technique may be from what we finally settle upon as nearest the ideal.

The nearest I have to a fixed idea in matters of technique is this: that in future we will use less filtration rather than more, and that we will depend more upon distance to improve the surface-depth ratio of dosage. The use of 1 mm. of copper instead of ½ mm. adds very greatly to the time and expense of the treatment, for a comparatively small increase in the depth-surface ratio. This loss in depth dose can easily be overcome by using one more port of entry. From the patient's standpoint it makes the treatment a very much less trying ordeal. I venture to predict that filtration will eventually settle down to somewhere near ½ mm. of copper—possibly ⅓₀ mm.—and that the now customary 50 cm. distance will be somewhat increased.

In the series of cases about to be reported the filtration used was ½ mm. of copper with the customary 1 mm. of aluminum. The distance was 50 cm. and the current, 5 ma. The total amount given at each series was divided into daily hours. The voltage was varied from 170 to 200 kv. roughly in proportion to the depth of the lesion below the surface.

Case I. Aged thirty-one, tenant farmer. Admitted to the General Hospital, Sept. 13, 1922, complaining of pain, swelling, and marked exophthalmos of three weeks' duration in region of left orbit. Tissue from a tumor over the left frontal sinus was removed for diagnostic purposes. The pathologist reported "large round-cell sarcoma." The patient was discharged Sept. 24th with a diagnosis of inoperable sarcoma involving the nose and the whole of left orbital region.

On Oct. 5th, shortly after my deep-therapy machine was installed, I agreed to try this apparently hopeless case. At that time there had been very rapid growth of all the nodular masses surrounding the left eye. In spite of the marked exophthalmos the eye was entirely hidden from view. The patient received a treatment of 450 ma. min., one-half laterally and one-half anteriorly, voltage only 170 kv., and was told to return in three weeks. The patient, however, presented himself again on the twelfth day after the treatment, with both eyes wide open, no exophthalmos, no swelling, and with practically every trace of the disease gone. At this time I gave him 300 ma. min., divided as before.

Four months later this patient had gained 30 lbs. and appeared to be in perfect physical condition, and such is his condition today. The striking features in this case are the marked susceptibility of the growth and the great rapidity of improvement.

Case II. Female, aged thirty-three. This case bears a striking resemblance to Case I, the chief difference being that in this case the onset was much more gradual and the tumor growth very much slower. She was first seen by Dr. W. L. Simpson, Dec. 26, 1922. At that time there was swelling of right side of face and right eye which she stated was of eight months' duration. From Dr. Simpson's case notes it appears that the patient had a negative Wassermann, that the swelling of the face gradually increased, that a tumor about the size of a hickory nut appeared just external

to the last two upper molars on the right side, and that the exophthalmos became very marked. On March 17, 1923, the growth was removed by way of the mouth. The tumor removed was the size of a walnut, not encapsulated and not attached to the bone. Pathologist's report: "round-cell sarcoma." The patient was referred to me for roentgen therapy, and on March 26, 1923, was given 200 ma. min. through an anterior exposure. The following day she was given 300 ma. min. through a lateral exposure, voltage in each case being 175 kv. She was next seen on April 10th, at which time the exophthalmos, the swelling about the eye and all signs of the tumor had disappeared. The pain and feeling of tension had also subsided. She was given at this time 200 ma. min. through a lateral exposure, and 100 ma. min. on April 20th, though I could see no indication for it. This patient was last seen by me on August 10th, four and one-half months from the date of the first treatment, and was apparently in perfect condition. She had gained 25 lbs. in weight. Dr. Ellett examined her at that time and reported everything in the region of the eye normal.

Case III. Female, aged fifty-five, referred by Dr. E. M. Holder. Abbreviating from Dr. Holder's case history we find, Jan. 12, 1911, cystic tumor growing from both ovaries almost filling abdomen. Inside, the sac of tumors presented a soft cauliflower appearance. A panhysterectomy was done. Pathologist reported the tumors to be sarcoma. Continuing Dr. Holder's case history we find, eleven years later, on Sept. 22, 1922: patient has enjoyed good health until past two years; for that period she has had some pain in abdomen. A week ago she noticed a discharge from navel which is viscid and malodorous. She has lost some weight.

Physical Examination. A mass about the size of a large dinner plate seems completely fixed in anterior abdominal wall. Mass is flat from before backward and is probably four inches in thickness. Navel purplish in color, bulging and discharging a viscid and offensive fluid.

Diagnosis. An inoperable malignant growth, the nature of which cannot be determined without section.

This patient was referred to me for treatment Sept. 25, 1922, before my high-voltage machine was installed. From Sept. 25th to 30th she was given full skin tolerance doses through three fields, anterior, and right and left lateral, with a current of 110 kv., distance of 14 in. and with 4 mm. of aluminum filter. Three weeks later the skin was somewhat tanned, but there was very slight, if any, improvement in the size of the growth. From Oct. 20, 1922, to Feb. 22, 1923, she received a total of 3250 ma. min., divided about equally into four series of treatments. In each series were three treatments, one anterior and two lateral, the factors in each case being 175 kv., ½ mm. Cu. and 1 mm. Al. filter, and 20 in. distance.

The patient came for examination April 29, and appeared to be entirely well. I saw her again on Sept. 4, 1923. At that time Dr. Holder, who had referred the patient, examined her with me. Neither of us could find any trace of the tumor which had one year ago been incorporated in the whole anterior abdominal wall. The navel is deep, dry, and healthy in appearance. The patient has regained all of her 20 lbs. of lost weight, and is symptomatically well. The skin is practically normal in appearance.

A feature of interest in this case is that this growth seemed to be resistant to skin tolerance doses of low voltage, and began to improve promptly on less than skin tolerance doses of high voltage.

Case IV. This case, having all the clinical signs and symptoms as well as radiographic evidence of an advanced lymphosarcoma of the mediastinum, was reported in detail at the February meeting of the *x*-ray section of the Southern Medical Association. At that time the patient had been symptomatically well for about six months. The fact that an additional seven months have now passed, during which time the patient has remained perfectly well, is my reason for making this supplementary report. No treatment has been given for about one year. A letter from the patient a few days ago stated that so far as he could tell he was in perfect health.

This case began treatment on low voltage, and improvement was rapid, as it

always has been in similar cases. High voltage was used in the later treatments. Since this patient, a man of twenty-nine years, has remained well without treatment far longer than the average case of lymphosarcoma of the mediastinum, it has occurred to me that possibly the more penetrating rays were able to reach in lethal dosage the deeper-seated portions of the tumor, whereas in those cases treated by low voltage the more remote parts of the tumor were sufficiently protected to remain alive and later to spring into activity, causing a regrowth of the tumor.

DISCUSSION[1]

DR. D. Y. KEITH, Louisville. In reference to the sarcomas that Dr. Lawrence reported, I am sure all of us have had similar experiences. Most of those of the type that he has shown respond very quickly to radiation. He has shown unquestionably that the higher voltages will reach tumors situated deeper in the body than voltage of 110 or thereabouts, but in the pelvic case that he reports, which did not respond to radiation of 110 volts with a filter of 4 mm. of aluminum and which did respond later with higher voltage and filtration, I can see no reason for attributing the result to the higher voltage. Occasionally we see cases of this kind that do respond to the second application more than they do to the first. I am sure all of us have seen this in our older therapy with the lower voltages.

I believe we should all be very careful about filtration. I believe also that we are going to learn more in the treatment of neoplasms, whether it be sarcoma, or carcinoma by being real clinicians, and we will all have an idea as to which filtration will be better for certain types of tumors. I am positive that filtration means as much to us as voltage. We showed before the Central Section of this Society at St. Louis two years ago in February a series of carcinoma that had remained well three and a half, and one for five years, after treatments. I would like to say that those patients are all still alive. Some of them were considered inoperable before we saw them and are absolutely free of symptoms at present. That is with the lower voltage, and given over three, four or five series, and the patient observed for at least six or nine months' time, coming in usually at the end of a month for the first series, six weeks later for the second, and then coming every three or four months. By keeping track of them that way for a year or more we can learn more about filtration.

In regard to Dr. Evans' paper, he has very definitely shown, as was indicated yesterday, that there is a limit to radiation of any tissue and that we can do a great deal of harm by too much radiation. A very interesting point that he brought out is that we unquestionably have certain classes of tumors that do not respond to radiation. He spoke particularly of metastasis from bone sarcoma. I believe he failed to state whether or not the primary tumor had been rayed, and whether or not it showed any response. Some of you have seen in the exhibit our plates of a periosteal sarcoma. This tumor was rayed heavily with high voltage because the patient's physician insisted on its being rayed before operation, as he had had a few cases that had shown good results, a very brilliant result being obtained in one case. This patient had very definite relief from her pain; there was no change whatever that we could see in the tumor except evidence of a little more calcification than in the films made before treatment. She died with a cerebral embolism after operation. I am sure if she had lived long enough and had had metastases, we would have found the same condition true—that they would not have reacted to radiation.

DR. H. J. ULLMANN, Santa Barbara, Calif. I wish to add a little point to the question of the treatment of sarcoma. I have had the opportunity to see 3 cases of lymphosarcoma in men all close to or over seventy years of age, one just under seventy, one seventy-eight, and one over eighty. We never were able to make a biopsy on the youngest of the three. He had large masses on each side of the neck. The clinical diagnosis of the surgeon was lymphosarcoma. He had had treatment with long-wave therapy with divided doses, at one week intervals, without any change. That is rather unusual, because we expect lymphosarcomas to respond rather readily to radiation. I gave him one series over the lungs, for he had some mediastinal shadows, and one series over the neck masses as soon as the reaction from the fractional dosage had subsided. There was no response whatever in the size of the tumors in the neck, but there was a drop in the temperature which he had been running. Unfortunately, we were unable to follow this case, because he became discouraged within three or four weeks of the radiation, not having had immediate response, and shot himself.

The second case was a man I think eighty-six years of age, with glands in the neck, the axilla, and the mediastinum. He responded very well to the first series, none of which were really massive doses. In about eight weeks they

[1] This discussion has reference to the preceding paper by Drs. Evans and Leucutia, as well as to the above.

began to grow again and he received another series. He received still a third series, and the masses were going down nicely, and his condition seemed to be very good, when he began to run down like a clock. I mean by that that his temperature began to fall, his pulse-rate began to fall, while still remaining good, and he died, as far as the clinical evidences indicate, an old-age death. Unquestionably it was hurried by his radiation and his tumor. We had an autopsy and found nephritis, bronchial asthma, and a few other things in addition to the trouble in his neck. The masses in the neck and the axilla had been replaced practically entirely by connective tissue, distinctly healing. Those in the mediastinum were going through the same course, but to a lesser degree.

The third case was a man seventy-eight years old who developed glands in the neck, as his physician said, and he lanced them. I urge those of you who have never seen a lanced lymphosarcoma, not to do it. He was then brought in for radiation. At that time he had large masses on the right side of the neck which were draining, smaller masses on the left side, masses in both axillae, both groins, and epitrochlear regions. Biopsy on the groin mass was reported lymphosarcoma. He was given his first course of radiation, and with the exception of the glands in the neck which had been lanced, all the masses simply melted away.

An interesting point is that the epitrochlear glands disappeared at the same time, although they were not rayed. The area that had been opened continued to open itself wider and wider. Muscles broke down, blood vessels broke down and sloughed out until he had an opening in the side of his neck one could almost put a fist in. So that area alone was given a very large dose through only ¼ mm. of copper, and immediately began to heal. It was healing beautifully, the masses had disappeared, the skin was filling in, when he was chilled driving in from his ranch about 120 miles away, developed pneumonia and died.

We obtained a limited autopsy; that is, we were allowed to remove specimens from the defect on the side of the neck. I have not had a microscopic report as yet, but cutting them was like cutting cartilage. Even the muscles overlying the enlarged glands felt fibrous to the knife, and there were no enlarged glands to be found. There were a few small ones about normal size in the depth. I report these because of the marked fibrotic changes, and the one case that failed to respond.

Dr. A. C. Christie, Washington. I would like to speak very briefly about these lung changes that Dr. Evans mentioned in his paper. Just a year ago at the Los Angeles meeting my associates and I reported a number of cases in which we had observed marked lung changes after treatment of the breast and of other lesions about the chest. We believed then, and are fully convinced now, as I think everyone is, that there is a very definite limit to the amount of radiation which we can use over the chest without getting permanent and sometimes very serious changes in the lungs.

I think these slides of Dr. Evans' not only prove very definitely that there are permanent changes produced in the lung by radiation, but show quite conclusively the cause of the changes.

Previous to about eighteen months ago nearly everyone believed that all these changes were due to the extension of the carcinoma, but I think it is definitely proven now that they are the result of radiation, and it shows that there is a very definite limitation to the amount of roentgen ray that we can use over the chest without doing permanent damage to the lungs. Dr. Evans has shown quite definitely what these changes are; that they begin with an infiltration and finally result in a very extensive fibrosis, not only in the lung itself, but in the pleura. It was noticeable on the slides that the lung that received the most radiation was very much retracted—it was much smaller usually than the lung that received the lesser amount of radiation—due to the extensive fibrosis through it, the retraction of the heart and the great thickening of the pleura on that side.

The one slide that Dr. Evans showed in which there were carcinomatous cells incarcerated in the mass of fibrous tissue is a suggestive thing, because we know that that takes place in other regions where carcinoma is treated. It suggests the inadvisability of operating on a carcinoma that was originally considered inoperable and that has undergone retrogression under roentgenotherapy. The carcinoma cells that are incarcerated may be liberated and cause metastases.

Dr. Lawrence (closing). I was so much impressed with the rapidity of the action of the ray in the first 2 cases that I recorded it.

The first young man had not been able to open his eye on acount of the generalized swelling about it, had not been able to see for a month, and twelve days after treatment he walked into my office seeing perfectly with both eyes.

The other patient, as I have mentioned, said that every distressing symptom was gone in six days after the first treatment, and the swelling was all gone in fourteen days when she came for the second treatment.

TUBERCULOUS LOBAR PNEUMONIA (PNEUMONIC CASEOUS TUBERCULOSIS)*

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IN recent years the practice of roentgenographing acute inflammatory processes of the lungs has given us much information as to the mode of onset, character, and course of this group of diseases, and has brought to our attention many conditions of obscure nature. In a study of lobar pneumonia recently undertaken[1] an occasional case was encountered having symptoms of lobar pneumonia and a corresponding roentgenographic picture of lobar consolidation, but which ran a more protracted course and was ultimately proven to be of tuberculous origin. In the last four years 13 cases have been encountered which could be established as undoubtedly of this type.

The clinical course of these cases varied from that seen in true lobar pneumonia of uncomplicated inflammatory origin. The onset may be sudden, with chills or chilly sensations, followed by high temperature, rapid respiration and pain in the chest. As a general rule, however, patients affected with this type of tuberculous pneumonic involvement do not present the same critical picture as true lobar pneumonia. The respiration is rapid but not to the degree of dyspnea attained in inflammatory cases. The leucocyte count may be high, but never, in our experience, has it attained the proportions encountered in pneumococcus lobar pneumonia. The sputum is tenacious and yellow, often streaked with blood; in none of our cases was it of the prune-juice type, although this type of sputum has been reported by others in connection with the disease. On the whole the patients do not appear so sick as individuals afflicted with pneumococcus lobar pneumonia. Not all cases are so acute. Many are of a much less severe nature and follow a more chronic course.

The site of the lesion has been chiefly in the upper lobes, one occurring in the left upper, one in the right upper and middle, and one involving the entire right side; the remainder were in the right upper lobe. This is in accord with the experience of others; a case of right middle-lobe involvement is mentioned by Assman[2]; lower lobe involvement is described by Osler[3] and massive involvement of an entire lung shown by Delafield and Prudden.[4]

Defervescence is by lysis and the temperature usually settles down to the septic type. The clinical course of pneumococcus pneumonia is so variable, however, that it is almost impossible at the beginning to make the differential diagnosis, and it is not until the time for crisis has passed that suspicion is aroused. Days and weeks pass and there is no clinical evidence of resolution of the consolidation, and the fever continues. The examination of the sputum discloses large numbers of tubercle bacilli and in this manner the true nature of the condition is determined. Roentgenographically considered, the consolidation, when at its height, resembles in all respects that of lobar pneumonia. Dense consolidation is seen, confined to one or more lobes, often with a relatively small amount of involvement elsewhere in the chest. The exact method of invasion of the process cannot be indicated with certainty, no case having been observed where the consolidation, starting at a single point, advanced to involve an entire lobe. In 2 cases of our series the consolidation was first noted in the hilus region from which the process extended out along the lower border of the upper lobe, suggesting that this may be the method of advancement of the lesion. None of the cases observed, however, went on to complete consolidation of the entire lobe. After rest in bed, the acute process subsided in both of these cases within a few weeks. The condition seems prone to occur in locations previously the site of mild tuberculous involvement. Two of our cases, which were of this type, had previously been under observation for mild tuberculous lesions (incipient tuberculosis); the

* Read at the Twenty-fourth Annual Meeting of THE AMERICAN ROENTGEN RAY SOCIETY, Chicago, Ill., Sept. 18-21, 1923.

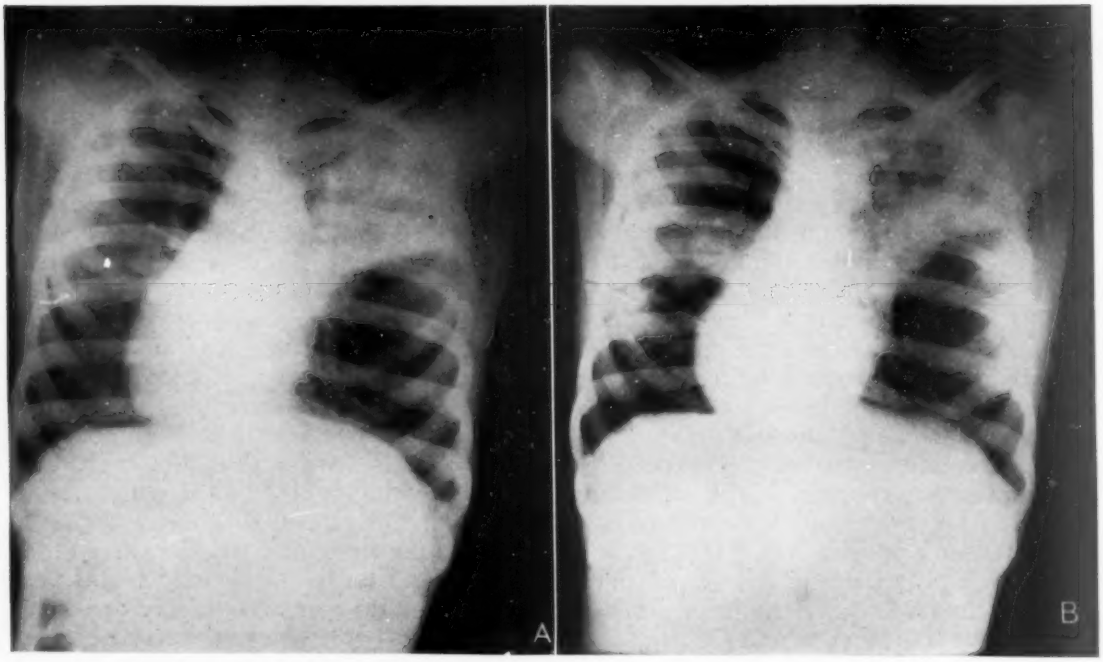

FIG. 1a. Acute pneumonic tuberculosis of lobar type, involving right upper lobe. Little if any involvement elsewhere in the chest. The condition was considered lobar pneumonia until failure of resolution and continuance of fever indicated the true nature of the disease.

FIG. 1b. About three months later some resolution has occurred and beginning cavity formation is apparent. Tubercle bacilli were found in the sputum in large numbers.

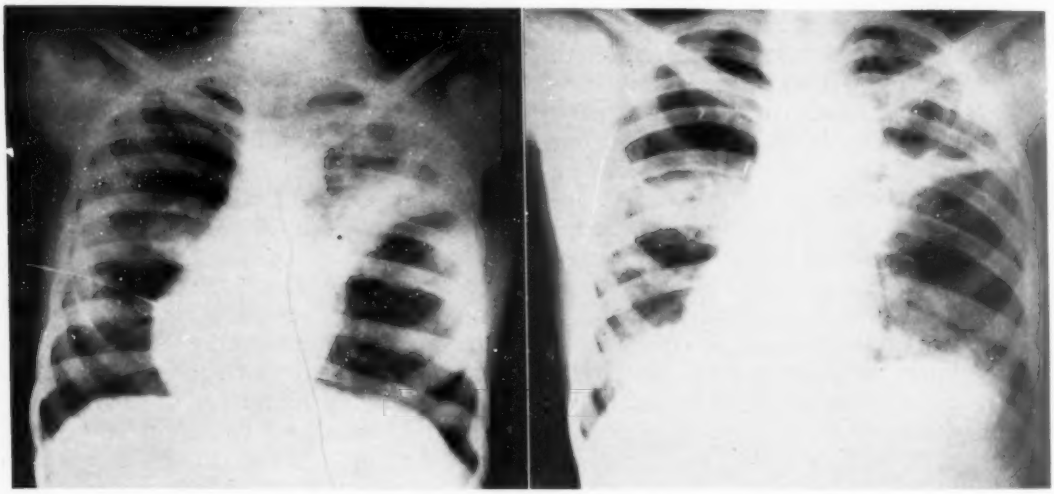

FIG. 1c. Still further resolution some time later.

FIG. 1d. Almost complete disappearance of the consolidation, but numerous large cavities are present and there is evidence of fibrosis. The entire process required about six months. There appears to be an increasing infiltration at the opposite hilus. The condition was ultimately fatal.

acute lobar consolidation occurred at the site of the previous disease. This acute process seems prone to develop in individuals previously afflicted with tuberculous disease, who, by reason of their duties, are subjected to severe physical strain and long hours of work. Lesions which would not cause much concern in individuals in the ordinary walks of life may assume great proportions and should be viewed with greater concern when occurring in individuals whose pursuits demand long working

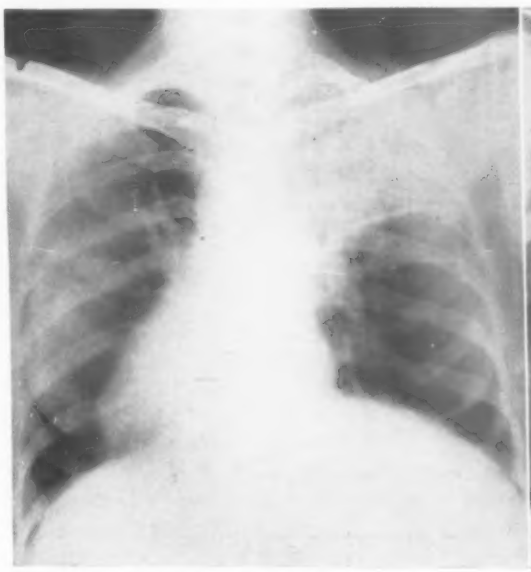

FIG. 2a. A case showing the lesion in the right upper lobe. Of 13 cases, 10 showed involvement of the right upper lobe.

FIG. 2b. Involvement of the right upper and middle lobe.

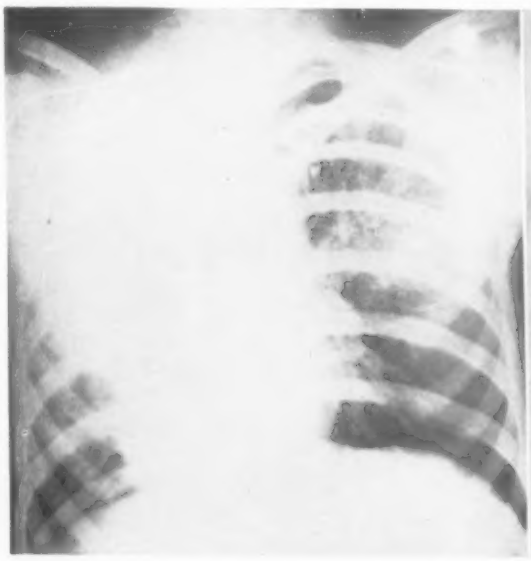

FIG. 2c. Involvement of the upper portion of the left lung. Within a short time the process spread to involve the entire left lung (Fig. 2d).

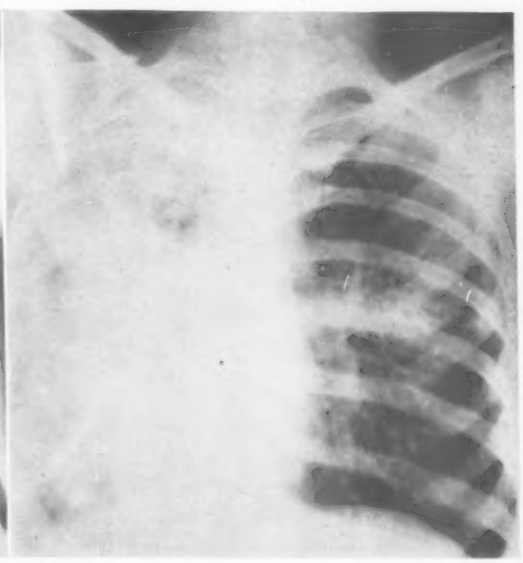

FIG. 2d. Complete involvement of left lung with beginning cavity formation.

hours and hard work. Nurses, for example, previously afflicted with what would seem a trivial lesion in individuals engaged in the ordinary pursuits of life, are especially prone to the development of this type of lesion owing to the character of their work.

Resolution of the consolidation requires several months. Weeks and even months may elapse without material change in its character. Gradually, however, the shadow, previously of more or less uniform density, becomes mottled and blotchy in appearance and there is evidence of cavity formation. Cavity formation has been the ultimate result in all but one of our cases. The cavities are usually multiple, well-defined, and occasionally become fibrosed. With a single exception the mark of the lesion remained, and even in the more favorable cases there was never complete resolution of the process.

Pathologically these cases represent a massive caseous tuberculous pneumonia with large areas of caseation and formation of ragged cavities. According to Delafield and Prudden[4] the tubercle bacillus causes three types of reaction in tissues; the production-type, causing the proliferation of connective tissue cells, and fibrous tissue formation; exudative type, causing migration of cells from the blood vessels and formation of exudate; and the necrotic type, resulting in destruction of tissue from the toxins of the microorganism. The exudative type is the type occurring here. A large part of the process is inflammatory in character and it is possible that the ultimate resolution of the greater part of the consolidation shadow represents an absorption of this inflammatory exudate. Prudden has shown, however, that the tubercle bacillus alone can give rise to this exudate and that the associated infection by pyogenic microorganisms is not necessary. A review of the literature reveals that acute pneumonic types of tuberculosis have been known for a long time and were described long before the *x*-ray was discovered. Many years ago an acute form of tuberculous pneumonia was recognized which simulated, at the onset, lobar pneumonia, but which failed to run the same clinical course. Osler[3] describes this pneumonic type of tuberculosis as follows: "In the pneumonic form one lobe may be involved, or in some instances an entire lung. The organ is heavy, the affected portion airless, the pleura is usually covered with a thin exudate and on section the picture resembles closely that of ordinary hepatization. . . . There may be smaller areas which are of peculiar yellowish-white color and distinctly caseous. The most remarkable picture is presented by cases of this kind in which the disease lasts for some months. A lobe, or an entire lung may be enlarged, firm, airless throughout and converted into a dry yellowish-white cheesy substance. Cases are met with in which the entire lung from apex to base is in this condition, with perhaps only a small narrow area of air-containing tissue on the margin. More commonly, if the case has lasted for two or three months, rapid softening has taken place at the apex with extensive cavity formation. Osler[3] reports a series of 15 cases, and quotes Frankel and Traje's[5] report of 12 cases.

While many cases are acute in onset and rapid in their course (Tendeloo reported a fatal case on the sixth day), more chronic cases are encountered where the disease lasts for four or five months, death ultimately being from asthenia. Cases have been mentioned in which the process was followed by fibrosis, the patient remaining alive for four or five years. From the roentgenographic evidence it seems probable that more of the acute exacerbations which occur during a tuberculous disease may be of this type—less extensive in involvement but essentially the same pathological process—which do not go on to this unhappy ending but which are ultimately fibrosed and arrested. It even seems probable that such acute lesions may not all result in cavity formation where the area involved is small.

The meager mention of this lesion in the literature from the roentgenographic standpoint, and its confusion with some of the more acute types of lung infection have prompted this presentation.

It would seem, from the small series of cases quoted by Osler and other authorities, that the condition is quite rare.

This of course was before the advent of roentgen examination. It must be remembered that the roentgen ray has more readily detected these cases and established the true character of the lesion, which in many instances must otherwise have remained in doubt. To determine the relative frequency of this type of tuberculous lesion, a study was made in 1922 of the first 1000 cases examined for tuberculosis among which there were only two cases which could unmistakably be labeled

FIG. 3*a*. Peribronchial thickening and a few infiltrations in right apex. Symptoms were primarily of gastrointestinal nature and the patient was submitted for examination on this account.

FIG. 3*b*. Same case, scarcely more than a month later, after an acute exacerbation, with high fever, dyspnea and pain in the chest. Note the consolidation of the lower portion of the upper lobe and its abrupt limitation to the upper lobe. Tubercle bacilli were abundant in the sputum at the height of the exacerbation; they were never detected before.

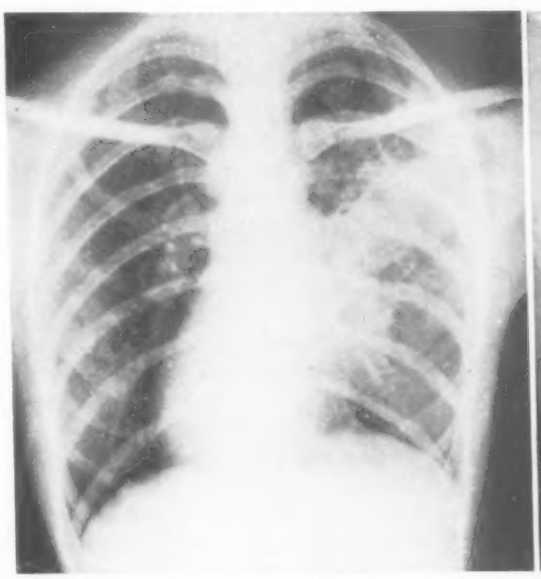

FIG. 3*c*. The condition sometime later after the subsidence of the acute symptoms. Note beginning cavity formation.

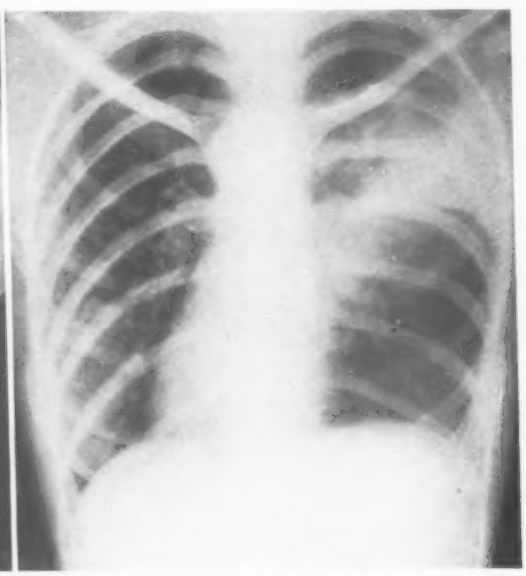

FIG. 3*d*. About one year later, showing fibrosis and definite cavity formation. The physical condition of the individual had so improved that she was permitted to resume her former duties.

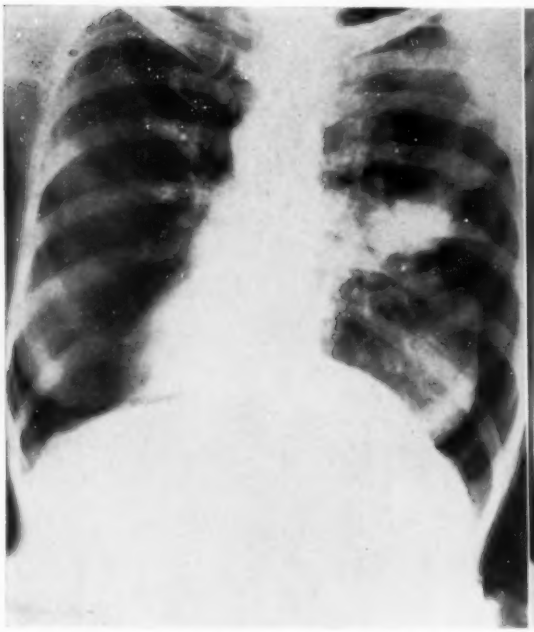

FIG. 4a. Acute consolidation in the right hilus with evidence of extension of the process outward through the lower portions of the upper lobe. Evidence of an old fibrosis of the upper lobe is also present.

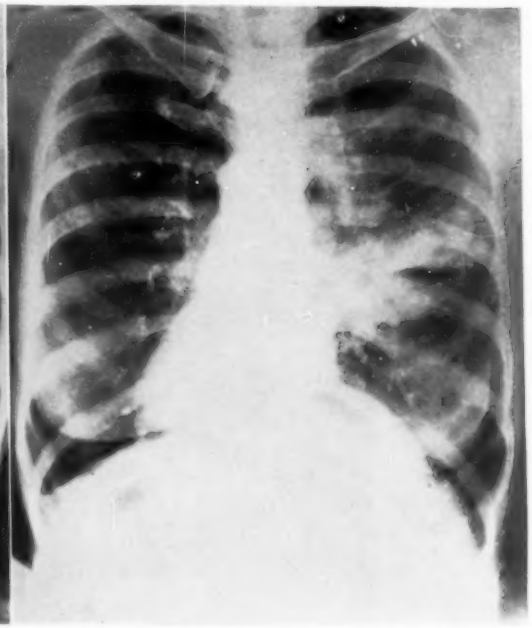

FIG. 4b. One week later showing definite extension of the process to the lower portion of the upper lobe.

FIG. 4c. Six months later showing complete resolution of the process. It is possible that this might have been an atypical hilus pneumonia of inflammatory origin with a coexisting tuberculous infection.

as of this type. That this does not represent the true state of affairs, I am quite confident. Such a study is of little value and cannot bring to light the true number of instances of this condition. The difficulty arises in the lack of minute correlation of clinical and roentgenographic findings. Without the clinical history of an exacerbation in a tuberculous process and a roentgenographic knowledge of the condition before the exacerbation, any fresh areas of involvement appearing in the lung which might thus be established as of this acute type, would necessarily fail of recognition and be considered an ordinary advancement of the disease. There is no doubt that the massive lesion involving an entire lobe or lung is a rare condition but I feel quite confident that smaller areas of consolidation, similar in pathological process, do occur with comparative frequency in connection with acute exacerbations in an established tuberculous process. The true nature of the process will be demonstrated only as the value of serial roentgenographic

examination of chest conditions becomes more generally appreciated.

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DISCUSSION

Dr. L. T. LeWald, New York. I think Dr. Sante's paper is really of great importance. It is a subject that has not been recorded much in roentgen literature but is well-known clinically. I think the differential diagnosis between croupous pneumonia and tuberculous pneumonia has not been drawn roentgenographically as it should be. I had two or three cases of tuberculous lobar pneumonia last year in general hospital work. The last case was very much along the line of the first case Dr. Sante showed, except that it went on to a complete consolidation of the entire right lung. Clinicians brought out the point that while the roentgen ray appearance might lead you to believe there was an ordinary pneumonia, the clinical evidence was very different, and the temperature not so high, and I think that point Dr. Sante has also made.

A ROENTGENOLOGIC STUDY OF BENIGN TUMORS OF THE STOMACH*

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THIS report is based on a study of the roentgenologic findings in 23 cases of benign tumors of the stomach in which operation was performed in the Mayo Clinic. In 1921 Eusterman and Senty reported in detail the clinical, surgical and pathologic findings in 27 proved cases of benign gastric tumors, and since then 6 additional cases have been studied, making a total of 33 cases. Roentgenologic examinations were made in 17 of the first series and in all 6 in the second series.

While the available literature contains many excellent reports of the roentgenologic findings in individual cases of benign gastric tumors, apparently no series of cases has been reviewed with the purpose of ascertaining whether there are roentgenologic characteristics, either typical or suggestive of the pathologic process. With this purpose in mind, the study here reported was undertaken.

The average age of the 23 patients (13 males and 10 females) was forty-four years and four months, the extremes being sixty-nine and eight years respectively.

The tumors were classified pathologically, as leiomyomas, two; adenomyomas, two; fibromyomas, four; simple myomas three; fibromyomas, three; dermoid, one hemangiomas, five; polyposis, two and a single polypus, one. In more than half of the cases, superficial ulceration was found.

The growth was located in the cardiac end of the stomach in 2 cases; in the middle portion of the stomach in 7; and in the pyloric portion in 12. In one of the cases of polyposis, practically the entire stomach was involved, while in the other, the lesions were localized to the lower two-thirds. The lesion was on the posterior wall in 9 cases, on the anterior wall in 7, on both walls in 2, and on the greater curvature in 2; the exact location was not mentioned in 3 cases. These tumors varied in size from a large dermoid, weighing 1,000 gm. to a very small polypus about 2 cm. in diameter.

As has been pointed out, benign gastric tumors do not present definite, characteristic syndromes. However, the cases have been grouped from the standpoint of the clinical history and the type of complaint. In 5 cases the complaint simulated carcinoma of the stomach; that is, there was a history of loss of weight with more or less

* Read at the Annual Twenty-fourth Meeting of The American Roentgen Ray Society, Chicago, Ill., Sept. 18–21, 1923.

digestive disturbance and anemia. In 4 cases a definite history of primary digestive trouble, simulating that of ulcer, was elicited. In 10 cases the trouble was extremely indefinite; in 4 cases the principal, and practically only complaint was that of hemorrhage from the gastrointestinal tract. Eleven patients had had either melena or hematemesis. In 1 case, a leiomyoma at the cardia, there was a history of dysphagia and regurgitation of food. Gastric retention was noted in 3 cases; these also revealed a six-hour retention following the barium motor meal. In but 4 cases was a palpable mass discovered. The roentgenologic findings were:

1. "Obstruction at the cardia with diffuse dilatation of the esophagus." This proved to be a leiomyoma in the cardiac end of the stomach, producing marked obstruction of the lower esophagus.

2. "A filling defect in the pyloric end of the stomach, unusual in appearance." At operation a fibromyoma was found, attached to the posterior wall in the pyloric end of the stomach, the attachment being so pedunculated that it permitted a prolapse of the tumor into the duodenum.

3. "A filling defect in the pyloric end of the stomach, either cancer or syphilis." This was a fibroma in the pyloric end of the stomach, producing marked obstruction.

4. "Lesion in the pyloric end of the stomach." This was a large fibroma (3 by 25 cm.) in the pyloric end of the stomach.

5. "Lesion at the outlet of the stomach" (2 cases). In 1 case there was a small fibromyoma on the anterior wall near the pylorus; about 7.5 cm. above the tumor was a fairly deep perforated gastric ulcer. In the other case there were multiple myomas on the posterior wall near the pylorus. In both cases there was a six-hour retention with pyloric deformity.

6. "Cancer of the stomach" (2 cases). In each of these cases there was a hemangioma on the anterior wall in the middle portion of the stomach. One tumor was pedunculated, the other closely adherent to the mucosa, and both produced smooth filling defects, deforming slightly, but not encroaching on the lesser curvature.

7. "Perforated ulcer on the lesser curvature of the stomach." At operation the ulcer was found, and also a small adenomyoma on the posterior wall near the pylorus.

FIG. 1 (Case A136147). A large dermoid attached to the posterior wall, displacing the stomach upward.

FIG. 2. Gross specimen of case shown in Figure 1.

8. "Stomach deformed and displaced upward; no obstruction to barium meal." Operation revealed a large dermoid, weighing 1,000 gm. and attached to the musculature of the posterior wall of the stomach, but not encroaching on its lumen.

9. "A central, cyst-like filling defect in the duodenal cap" (2 cases). One of these proved to be a hemangioma 7 by 5 cm. attached to the pylorus and prolapsed into the first portion of the duodenum, the second was a myoma which also prolapsed from the stomach into the duodenum. In the latter case the roentgenologist suggested the probability of a papillomatous or pedunculated tumor.

10. "Polyposis" (2 cases). In both cases the characteristic mottled, extensive filling defects were noted, and both diagnoses were confirmed at operation.

11. "Duodenal ulcer" (3 cases). In 2 of these a duodenal ulcer was found by the surgeon, but a benign tumor was also present. In the first case a deformity of the greater curvature was noted but this was interpreted as being due to spasm secondary to the duodenal ulcer. At operation a hemangioma on the posterior wall of the stomach was found at this point, which no doubt had caused the deformity of the curvature; a duodenal ulcer was also present. In the second case, besides the duodenal ulcer, the surgeon discovered a small pedunculated fibroma in the pyloric end of the stomach. In the third case, no ulcer, but a hemangioma arising from the pyloric ring, was discovered.

12. "A filling defect on the posterior wall of the stomach, circumscribed and punched-out in appearance" (4 cases). In these 4 cases the roentgenologist suggested to the clinician that the lesion might be benign. The first case proved to be a hemangioma in the pyloric end of the stomach near the greater curvature; the second was a fibromyoma on the posterior wall in the middle portion of the stomach, the third was a fibromyoma on the posterior wall in the cardiac end, and the fourth was a myoma on the anterior wall in the middle portion of the stomach.

13. A negative report was made by the roentgenologist in 2 cases. At operation one growth proved to be a polypus; about 1.5 cm. on the posterior wall of the stomach 5 cm. above the pylorus; the other was a small adenomyoma, also on the posterior wall near the pylorus.

From a review of the roentgenologic findings in these 23 cases it seems that benign gastric tumors manifest certain signs roentgenologically, which differ from those found in malignant or inflammatory lesions. If these signs are not characteristic, they are at least suggestive:

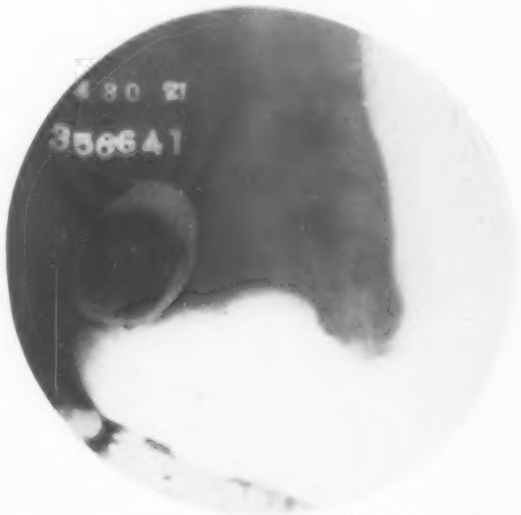

FIG. 3 (Case A356641). Hemangioma arising from the pyloric end of the stomach, prolapsing into duodenal bulb.

1. They produce a filling defect that is circumscribed and punched-out in appearance.

2. The filling defect is usually on the gastric walls, leaving the curvature regular and pliant.

3. While the rugae are obliterated in the immediate area of the tumor, just as in inflammatory and malignant lesions, the rugae surrounding a benign tumor are more nearly normal in their arrangement and distribution.

4. They cause little or no disturbance in peristalsis, and retention is uncommon except when the lesion is at, or very near, the pylorus.

5. They do not reveal a niche, nor is there any incisura or other evidence of spasm.

6. They are rarely sufficiently large to be palpated.

FIG. 4 (Case A434648). Myoma of the pyloric end of the stomach prolapsing into the duodenum.

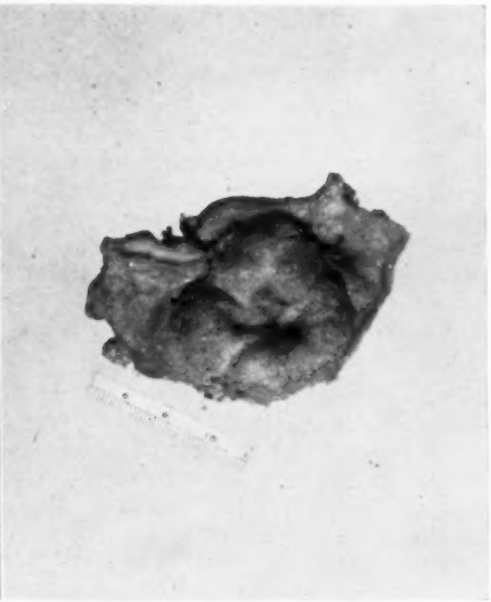

FIG. 5. Gross specimen of case shown in Figure 4.

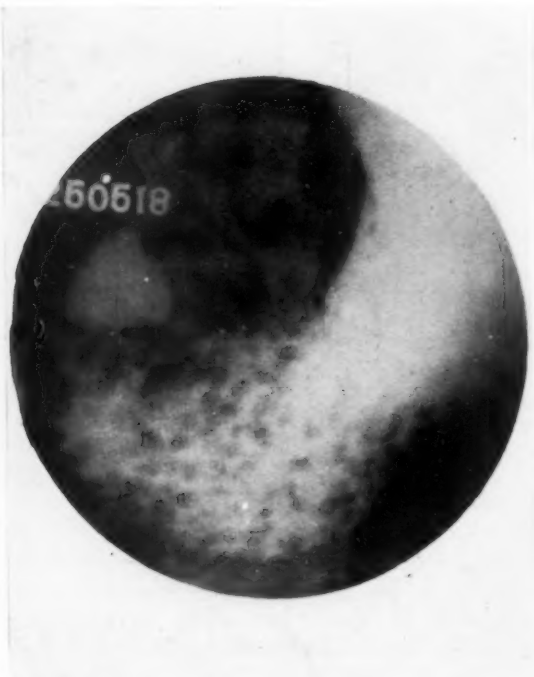

FIG. 6 (Case A250518). Extensive gastric polyposis.

FIG. 7. Gross specimen of case shown in Figure 6.

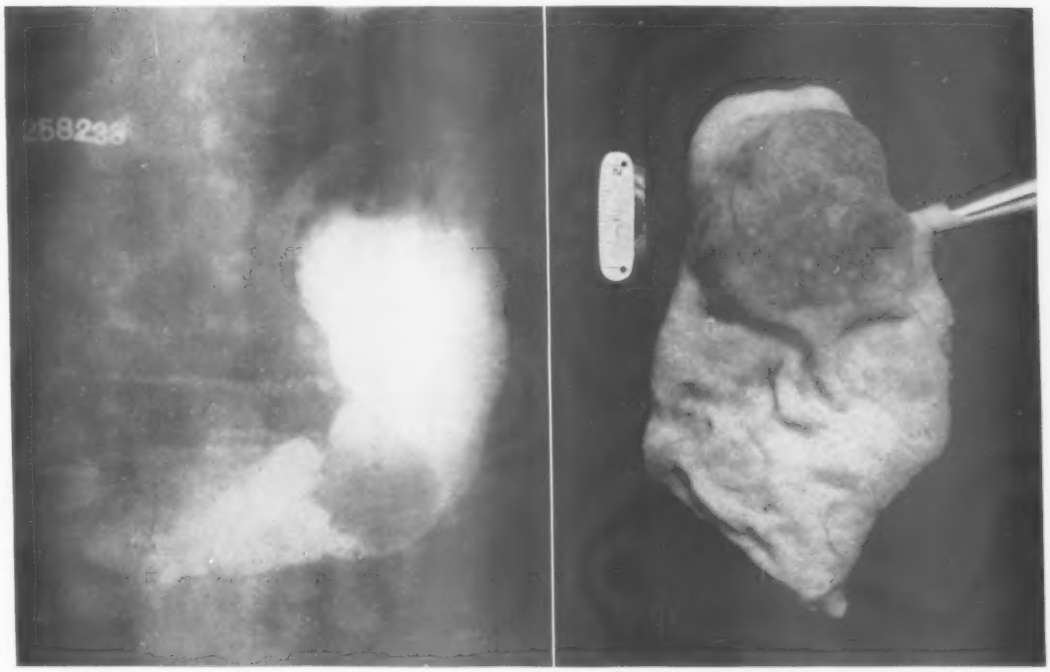

FIG. 8 (Case A258233). Hemangioma of body of the stomach.

FIG. 9. Gross specimen of case shown in Figure 8.

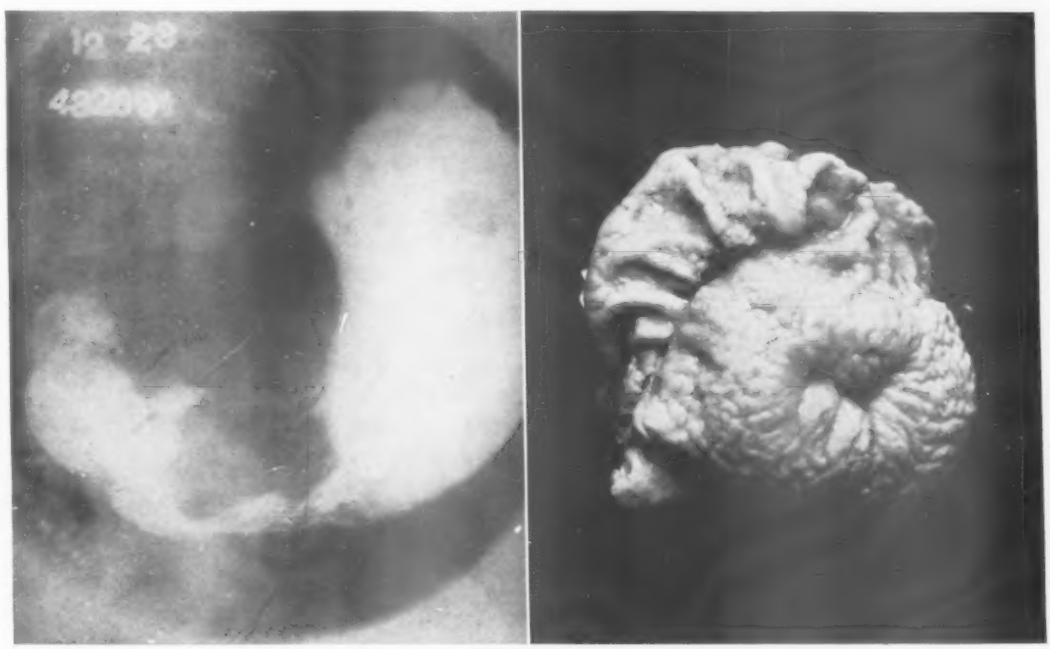

FIG. 10 (Case A432691). Myoma of the stomach with superficial ulceration.

FIG. 11. Gross specimen of case shown in Figure 10.

Probably the most essential feature in the examination is the close and complete approximation of the walls of the barium-filled stomach. This can be accomplished only by deep and thorough palpation and manipulation; thorough relaxation of the abdominal muscles is, of course, necessary. The patient should be rotated in both lateral directions, and the stomach carefully scrutinized in the horizontal and vertical positions. The solution of barium should be closely observed as it enters the cardia and passes over the posterior wall, for occasionally a tumor projecting from the posterior wall will cause a splitting of the column, thereby giving the first indication of its presence. A very small benign tumor is difficult and sometimes impossible to visualize; however, even a very small tumor near the pylorus will usually produce a definite filling defect.

Differentiation roentgenologically, of benign tumors and other gastric lesions can seldom be absolute, but in many instances the roentgenologic signs warrant an attempt at such a distinction.

Medullary carcinoma of the stomach produces a filling defect usually irregular in contour and more diffuse in its involvement; it is most commonly found on the curvatures, and when on the walls, the curvatures are prone to be involved. A palpable mass corresponding to the filling defect is usually noted, and there is a marked disturbance in both peristalsis and motility.

The crater of an ulcerated cancer holds a layer of the opaque medium, producing the denser meniscus shadow, as described by Carman. The protrusion of a benign tumor produces an area, unfilled by the medium, with a shadow much less dense than that of the surrounding zone.

Scirrhous carcinoma and syphilis produce a regular, diffuse, filling defect in the stomach with a narrowed lumen and an absence of peristalsis.

A ring carcinoma, a saddle ulcer with a demonstrable crater, or a localized syphilitic lesion, when situated near the pylorus, produces a roentgenologic picture similar to that of a benign gastric tumor. However, it seems that the deformity caused by a benign tumor is less extensive and that there is much less distortion of the greater curvature than is common in the other lesions mentioned. A small gastric tumor situated near the pylorus and prolapsing into the duodenum produces a deformity of the cap which resembles that caused by a duodenal ulcer. But in such instances the deformity is more regular and central than the spastic irregularity caused by an ulcer.

The mottled appearance of gastric polyposis is so typical that the diagnosis is fairly easy, but it must be borne in mind that this picture may be simulated by the presence of multiple particles of food in a stomach filled with secretion.

From this series of 23 cases it would appear that there are no roentgenologic signs that are pathognomonic of benign gastric tumors. Nevertheless, certain findings are strongly suggestive of their presence, and when such signs are noted, the roentgenologist should hesitate to report the lesion as malignant and inoperable, especially if the clinical manifestations are indefinite.

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There is one unerring mark by which a man may know whether he is a lover of truth in earnest, viz., the not entertaining any proposition with greater assurance than the proofs it is built on will warrant. John Locke.

ORGANIC HOUR-GLASS STOMACH WITH SOME REFERENCE TO ITS SURGICAL TREATMENT*

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HOUR-GLASS stomach is commonly designated as that condition in which the stomach shows one or more constrictions at any point, or points, between the cardia and pylorus. In this paper we shall confine ourselves practically to those types producing intrinsic organic changes with only a passing mention of the spasmodic types. These constrictions, in the cases seen by us, have been more common in the middle and lower thirds of the stomach, which might be anticipated from the greater frequency of peptic ulcers occurring in these localities.

ETIOLOGY

Most of the older writers on this subject have classified organic hour-glass stomach as congenital or acquired. The weight of opinion at the present time, however, tends to exclude the former as a practical etiological factor. Moynihan[1] says, "An examination of several specimens and an earnest search through the literature of this subject has convinced me that there is no proof whatever of the existence of an hour-glass stomach due to a congenital deformity. In all the recorded examples of hour-glass stomach, where a full examination of the viscus has been made, ulceration has been found."

The type of cases we are considering are caused chiefly by some intrinsic ulcerative process with a resultant permanent change. The types of ulceration are largely the following:

1. Gastric or peptic ulcer.
2. Gastric carcinoma.
3. Gastric syphilis.
4. Tuberculous ulcers.

The condition may also be seen following the ingestion of certain corrosive chemicals with cicatrization following. The contraction following certain operations is also probably a more fruitful cause than has been supposed. Perigastric adhesions are also mentioned in the literature with considerable frequency as one of the causes.

Gastric ulcer, according to Moynihan[1] may cause hour-glass stomach in one of two ways:

1. The ulcer gradually deepens and as it approaches the serous coat of the stomach a few adhesions form binding the stomach to the abdominal wall anteriorly, or to the pancreas or liver. With the stomach thus anchored in its middle, the pouches, especially on the cardiac side, tend to sag, and this, together with the cicatricial change in the ulcer, results in the hour-glass form of the stomach.

2. Here the chronic ulcer in its healing has caused much contraction and induration and at the point of ulceration becomes markedly puckered and its lumen narrowed.

Gastric syphilis is likely to cause an area of stenosis extending over a rather wide area, the so called dumb-bell shaped deformity, in contradistinction to the relatively narrow constriction due to cicatrization, following peptic ulcer.

SYMPTOMS AND SIGNS

There are no definitely characteristic symptoms. The symptoms would depend somewhat on the location of the point of constriction, and the degree of patency of this. Those situated high in the cardia with a small upper sac may display signs of cardiospasm. In most cases these are symptoms of peptic ulcer with vomiting after meals. Usually there is considerable loss of weight and many patients are emaciated from the continued vomiting.

Osler[2] quoting from Moynihan gives the following signs as found clinically in this condition: "(1) In washing out the stomach part of the fluid is lost. (2) If the stomach is washed clean a sudden reappearance of stomach contents may take place. (3) 'Paradoxical dilatation;' when the stomach has apparently been emptied,

* Read at the Twenty-fourth Annual Meeting of THE AMERICAN ROENTGEN RAY SOCIETY, Chicago, Ill., Sept. 18–21, 1923.

a splashing sound may be elicited by palpation of the pyloric segment. (4) After distending the stomach, a change in the position of the distention tumor may be seen in some cases. (5) Gushing, bubbling, or sizzling sounds are heard on dilatation with carbon dioxide at a point distinct from the pylorus. (6) In some cases when both parts are dilated, two tumors with a notch or sulcus between are apparent to sight or touch. To these may now be added (7) a most characteristic *x*-ray picture."

Notwithstanding the many clinical signs that have been described from time to time it is a noteworthy fact that practically no cases are referred to the roentgenologist for examination in which this diagnosis has been correctly made beforehand, and there are relatively few recorded cases in the literature in which the diagnosis has been made clinically before operation.

ROENTGEN RAY EXAMINATION

It is evident that even if the diagnosis is made without the aid of the roentgen ray no idea is gained as to the size of the pouches, the position of the constriction, or the possible origin of the condition, so that very little aid in determining the type of treatment is obtained.

The roentgen examination should be made in the usual manner by means of the roentgenoscope in the upright and prone positions, followed by roentgenograms in either or both of these positions.

The picture of biloculation or hour-glass stomach may be shown by a number of conditions. Chief among these are, in the order of frequency: (1) Reflex (spasmodic), from lesions outside the stomach; (2) spasmodic, from intrinsic lesions as ulcer or carcinoma, and (3) organic hour-glass.

In cases of the reflex spasmodic type the exact etiology is often a most difficult matter to decide. The three most common causes are probably: (1) Chronic appendicitis; (2) chronic cholecystitis; (3) duodenal ulcer. The first two types can usually be relaxed by the administration of belladonna until the full physiological effect, dryness of the mouth and dilatation of the pupils, is obtained. The third type will in most cases be unaffected by belladonna, so that in all cases duodenal ulcer must be definitely excluded. Case, quoted by Barclay,[3] described this condition in 1913 noting it in sixteen cases of duodenal ulcer.

The intrinsic spasmodic type is often seen in connection with gastric ulcer and cancer. The contraction is usually opposite the ulcer and may vary from a slight indentation to a large, usually V-shaped defect. This is most difficult to differentiate from the true organic type, as antispasmodics have no effect upon it. Repeated examinations, especially after medical management, will often reveal its true nature.

Gastric carcinoma shows this spastic effect with considerably less frequency than ulcer and when seen, the typical filling defect due to the growth will usually make the origin clear. According to Carman,[4] this is manifested by an indrawing of the greater curvature opposite the growth and the contraction is much wider than the contraction due to ulcer which may be a very narrow slit.

The true organic hour-glass stomach resulting from the effects of the cicatrization following gastric ulcer will usually give the stomach the shape of the letter B; the lesser curvature forming the vertical line and the greater curvature being indrawn. In most cases the constricted area is rather short and with the sagging of the upper loculus it may be necessary to elevate this by palpation to see the constriction in its entirety. There is frequently a six-hour retention, although usually in this examination the upper loculus is found to be empty. In some cases the stomach is found to be fixed by adhesions. Many cases present a niche or accessory pocket on the lesser curvature at the point of narrowing, suggesting the origin of the constriction.

Undoubtedly a part of the constriction in many of these cases is spasmodic, and we have been struck by the relatively larger opening found at operation than was suspected from the roentgenogram. However, we have found practically no change in the opening following the physiological effect of belladonna.

In carcinomatous hour-glass, the findings are usually those of gastric carcinoma in which the involvement is of such a type that a biloculation of the stomach has

been formed. There is often irregularity of the outline, and a tumor can be felt confirming the suggestion of a new growth. The whole lumen of the stomach may be contracted down for a considerable distance giving the so-called dumb-bell stomach described in gastric syphilis by LeWald.[5]

In syphilitic hour-glass stomach we have observed few findings which roentgenologically will differentiate it from gastric carcinoma, and we believe that this diagnosis is usually made because of certain clinical findings which suggest a condition of a more chronic and less debilitating form than gastric cancer.

TREATMENT

The treatment in most cases of this type is surgical, if a permanent result is to be obtained. In following the course of these cases it has become apparent that the roentgenologist may be of considerable assistance to the surgeon in deciding upon the type of operation to be undertaken in any given case. If one considers the portion of the stomach constricted, the emptying power of the resultant pouches and the clinical condition of the patient, the best type of operative procedure can be foretold with considerable accuracy.

Moynihan[1] lays stress upon the fact that in the surgical treatment the pyloric opening must be taken into account as well as the point of narrowing, as the former may also be obstructed by a second point of ulceration. This point can be preoperatively determined by the roentgen-ray examination and a decision reached as to the advisability of arranging for drainage of the lower as well as the upper pouch.

Watson[6] favors gastrogastrostomy as the operation of choice if the circumstances are at all favorable for its performance. The advantage of this is that it allows a large communicating opening to be made between the pouches, thus avoiding the area of cicatrization with its thickened inelastic walls. He advises against resection of the constriction as being a much more dangerous type of operation, except in the simpler cases.

In a group of 37 cases Eustermann[7] reports 10 cases treated by gastrogastrostomy; posterior gastroenterostomy, 8; resection, 2; Hartman gastroplasty, 5; and the remainder by various single and combined operations.

In considering these cases one could begin by dividing them into three classes: (1) Those in which the point of narrowing is in the lower third; (2) those in the middle third; (3) those in the upper third.

Taking up the first class it will be apparent that in most of these the lower sac will be so small and the walls so much indurated that as a digestive factor it is of little consequence. Our greatest problem here, then, is to afford adequate drainage of the upper large pouch, which, barring other complications, can usually be best attained by a posterior gastroenterostomy. The small amount of stomach contents which goes through the point of narrowing will usually pass through the pylorus and will afford no further trouble.

In the second class we have two pouches of approximately the same size. Our problem here is to unite the two pouches, thus preserving the normal digestive function. This can be done by a gastrogastrostomy, making a large connection between the pouches, or by a resection of the constricted area. The former is much the simpler and is usually recommended because of its lower mortality, especially as many of these cases, because of long-continued vomiting, are emaciated and are poor surgical risks for any extensive operation. Resection may be undertaken if the constriction is short and there is no evidence of adhesions binding the stomach tightly to surrounding structures, and the patient is in fairly good physical condition. If retention is found in the lower sac, caused by obstruction at the pylorus, then some operation such as pyloroplasty or gastroenterostomy must be performed to relieve this. Some have also advocated gastroenterostomy openings in both pouches to relieve this condition.

In the third class, showing constriction in the upper third, it is desirable, if possible, to afford drainage to the lower pouch. This can be done by a gastrogastrostomy or some type of plastic operation. None of our operative cases has been in the third class.

No attempt has been made to designate all types of surgical measures which might be undertaken in cases coming under the foregoing classification, but rather we have attempted to indicate a few of the more generally used operations which are applicable in these cases.

Medical treatment in this condition is chiefly indicated as a temporary measure to improve the patient's general condition so that the appropriate surgical measures can be carried out. No permanent medical results could be expected in any case where the changes are due to fibrotic contraction. This treatment should be limited to those cases of spasmodic hour-glass due to some intrinsic lesion or to syphilitic hour-glass in order to remove all evidence of infection. Then if the hour-glass condition persists it can be safely assumed that it is fibrotic in nature, and can be treated accordingly.

FIG. 1. Hour-glass stomach with canal along lesser curvature. Old ulcer pocket present at point of constriction. Before operation.

FIG. 2. Same case as in Figure 1. After gastrogastrostomy operation, showing deformity. There was no retention in five hours.

CASE HISTORIES

CASE I. Female.

Complaint. Vomiting and gas on the stomach.

History. The patient gives a rather definite history of chronic ulcer with considerable vomiting during the last several years.

Roentgen Examination. A very definite hour-glass constriction was seen in the middle portion of the stomach with the channel on the lesser curvature (Fig. 1). The two pouches were approximately equal in size. There appeared to be the remains of the crater of an old ulcer on the lesser curvature at the point of constriction There was about 25 per cent retention in the lower pouch at the five-hour examination. There were also some adhesions in the upper right quadrant.

Operative Notes. Adhesions of omentum to gall-bladder and spleen. Indurated mass in the central portion of the stomach with some dilatation of the two gastric pouches. The pyloric opening was free. The other viscera were negative. A gastrogastrostomy was performed.

The second roentgen examination one month following operation showed a somewhat angulated stomach without any con-

striction (Fig. 2). There was considerable hypermotility and no retention in five hours.

This operation was performed four years ago and since that time the patient has been in excellent health with no recurrence of the previous trouble.

CASE II. Female, aged fifty-two.

Present Illness. Stomach trouble for the last twenty years consisting of pains in the upper left quadrant with vomiting after meals. Vomitus sometimes contains blood; occasionally there is melena.

Roentgen Examination. A definite constriction in the pars media of the stomach with the opening along the lesser curvature (Fig. 3). The pouches were approximately equal in size.

Operative Findings. Hour-glass stomach with ulcer of the stomach and adhesions around the gall-bladder. A posterior gastroenterostomy was performed, the posterior aspect of the upper pouch being approximated to the upper jejunum.

The second roentgen examination one month after operation (Fig. 4) shows that a posterior gastroenterostomy has been done in the most dependent portion of the upper pouch of the stomach; this is functioning very well. A small amount of barium also passed through the pylorus. The stomach was practically empty in five hours.

The patient has made an uneventful recovery and one year following operation is in excellent condition with no evidence of the previous trouble.

CASE III. Female, aged fifty.

Complaint. Distress in the abdomen, nausea and vomiting.

FIG. 3. Hour-glass stomach involving pars media, with canal along lesser curvature. Before operation.

FIG. 4. Same case as in Figure 3. After gastroenterostomy operation. Good emptying power.

Past History. Has had this complaint for fourteen years with two severe hemorrhages at the beginning of that time, and was under hospital care for one month.

Roentgen Examination. A definite constriction at the junction of the pars media and antrum (Fig. 5). The opening appeared to be along the lesser curvature of the stomach and several inches in length. The duodenal cap was negative. There was about 60 per cent retention in five hours, both pockets being well filled (Fig. 6).

Operative Findings. Appendix normal; gall-bladder buried in adhesions; hour-glass contraction of the stomach in the middle third which consisted of dense fibrous

tissue. A gastrogastrostomy was performed uniting the two pouches of the stomach.

The patient made an uneventful recovery and one and one half years after was in good health with no return of the previous symptoms.

CASE IV. Female, aged thirty-eight.

Complaint. Pain in stomach shooting up into the chest.

Present Illness. Sharp pain in stomach coming on one-half hour after eating, relieved by drinking milk. Usually vomits one-half hour after eating. Vomitus contains no blood.

Roentgen Examination. There is a definite hour-glass constriction in the pars media with the channel along the lesser curvature (Fig. 7). There is also a small crater formation extending out from the lesser curvature at the point of constriction. This appears to be an ulcer crater. The stomach was entirely empty at the five-hour examination.

Operative Findings. Hour-glass contraction in the pars media due to chronic indurated ulcer on the lesser curvature. A sleeve resection was done removing a circular cuff 2 in. wide. This gave the stomach a lumen admitting four fingers at this point.

The second roentgen examination one month following operation showed a constant point of narrowing in the pars media although there was a rather large lumen through this, producing no definite obstruction. The edges of this were smooth. The duodenal cap was negative. There was about 30 per cent retention in the stomach in five hours.

The third roentgen examination two months following operation (Fig. 8) showed the same point of narrowing in the pars media which was approximately the same size as at the previous examination. There was 50 per cent retention in five hours.

The fourth roentgen examination five months following operation showed the point of narrowing in the pars media to be somewhat narrower. The patient had been growing worse gradually and was in a weakened condition.

FIG. 5. Hour-glass stomach with canal along lesser curvature.

FIG. 6. Hour-glass stomach showing amount of retention in five hours. Same case as in Figure 5.

A second operation was undertaken and a gastroenterostomy to the upper sac performed but the patient died within two days.

CASE V. Male, aged forty-one.

Present Illness. Has had stomach trouble for twenty years. Complains of gas, nausea and distress following meals, which is relieved by vomiting. Has been gradually growing worse.

FIG. 7. Hour-glass stomach showing small ulcer crater on lesser curvature at point of constriction. Before operation.

FIG. 8. Same case as in Figure 7, following sleeve-resection of constricted area. Constriction of moderate degree persists.

Roentgen Examination. There is a large, deep crater-like ulcer located in the middle third of the lesser curvature. There is a rather deep constriction located opposite the ulcer involving the greater curvature with the channel along the lesser curvature. The stomach was completely emptied in six hours.

Operative Findings. Large crater ulcer in the middle portion of the stomach with a large amount of induration and contraction around this region. The pylorus and antrum were negative. A resection of this entire region was done and the cut ends of the stomach united. The patient had a rather stormy postoperative course and died about three weeks later.

CONCLUSIONS

1. Organic hour-glass stomach is usually caused by some intrinsic ulceration with resultant fibrotic contractures.

2. Clinical signs and symptoms are somewhat indefinite.

3. The roentgen picture is definitely characteristic and will often demonstrate the etiology.

4. The treatment is essentially surgical, and the best type of operative intervention can frequently be foretold from the roentgen picture.

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DEFECTS IN THE CONTOUR OF THE STOMACH SIMULATING HAUDEK'S NICHE*

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IN 1909 Reiche[1] showed the outline of a defect on the lesser curvature of the stomach in a case which came to autopsy, and a deep penetrating ulcer was found at the site. Haudek[2] was the first to describe in detail this defect or projection of the bismuth shadow as a sign of penetrating or callous gastric ulcer. More data on it was presented by him in the Archives of the Roentgen Ray in 1911.[19] In this article he states that up to the time of its publication he had observed 38 cases of gastric ulcer showing this symptom. In all but one of these cases the lesion was situated on the lesser curvature. The characteristics of the niche as observed by him were described as follows:

1. A diverticular projection from the stomach shadow on the lesser curvature.
2. The persistence of this diverticular shadow under palpation.
3. The presence of bismuth residue in the diverticulum.
4. The presence of a hemispherical gas bubble above the bismuth shadow.

Carman,[3] on the basis of his extensive experience at the Mayo Clinic, defines the niche as "the visualized crater of a penetrating ulcer, the cavity of which lies entirely in the wall of the stomach." He states further: "Its size may vary from a mere fleck to a considerable protuberance" and "it is worthy of note that a niche may be demonstrable even though the ulcer has not penetrated very deeply." He adds: "A small niche in any situation may be hidden or partially obliterated when the stomach is distended, so that careful observation should be made while the stomach is filling, especially while the patient is drinking the mixture." In conclusion he states: "The bulge between two peristaltic waves close together on the lesser curvature often looks very much like a niche, and conversely a true niche may be mistaken for this bulge. However, as the waves progress, the bulge moves toward the pylorus while a niche remains stationary, a screen study being necessary to make the distinction."

In 1920 Carman[4] reported that of 3,890 gastrointestinal cases examined roentgenologically at the Mayo Clinic in 1918 to 1919, 111 were diagnosed as gastric ulcer. Of these 88 were operated upon and the diagnosis confirmed at operation in 84 (95.45 per cent), but he does not state what percentage of these cases showed the typical niche symptom. Béclère[5] reported 10 cases which showed the niche and he considered the sign "absolutely pathognomonic of gastric ulcer" but states that he had observed it only in ulcers of long-standing, and Carnot, Harvier and Mathiew believe likewise. Cole[6] regards Haudek's niche as most important in the diagnosis of gastric ulcer and believes symptoms to be of practically no value in comparison with this direct evidence of the lesion, but in this connection he mentions the presence of the "bubble of gas," and with this qualification he is no doubt perfectly accurate. Diamond's[7] article strongly suggests that he considers the niche pathognomonic. Faulhaber[8] in 1910 agrees with Haudek's report and confirms his observation that it could not be made to disappear by palpation. Schlesinger[9] in his recent book agrees with Cole in that when a defined niche is present the diagnosis of gastric ulcer can be made without reference to the clinical history. Schulze,[10] during the war years in his country, employed the presence of the niche to prove an increasing incidence of callous gastric ulcer.

Other articles, all in agreement with what has been stated, have been presented by Åkerlund,[11] Carman,[12, 13, 14, 15] Carnot,[16] Haudek,[17, 18, 29, 20] Held and Gross,[21] Hess,[22] Holding,[23] Kupferle,[24] Levy,[25] Magee,[26] Reiche,[1] Schuller,[27] Scargill,[28] Secher,[29] Simon[30] and Singer.[31]

The very latest literature on the subject contains an article by J. Buscher[32] reporting observation of 700 cases of deep-seated

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ulcers roentgenologically visible. In these he reports that hour-glass contraction and the niche, either persistent or temporary, are the most important signs. He, however, makes diagnostic distinction between true and spastic hour-glass contraction. The greatest interest is attached to the niche, especially since Haudek and Faulhaber had called attention to it, and he definitely states that the existence of a niche may be assumed to warrant the diagnosis of gastric ulcer. His description of a niche is: "A diverticular spot of barium extending from the main shadow, which pressure cannot dislodge and which represents a callous or penetrating ulcer." He draws attention to the various shapes and sizes of niches, describing them as diverticular sacculations, and those on the lesser curvature as of sugar-loaf, pedunculated and mushroom form, varying in size from a lentil to a hazelnut or walnut. The only possibility of error to him is when adhesions form a pouch by traction on the walls of the stomach, resulting in deceptive findings.

On the other hand Kurtzahn,[33] on the basis of 100 observations in gastric ulcer, states that the niche, continuous spasm, rolling in of the lesser curvature and circumscribed pressure points are the important factors, with the typical niche present in about 25 per cent of ulcer cases. After drawing attention to the possibility of niches on the anterior and posterior walls, he states that in some cases, despite a pronounced niche, doubt as to the diagnosis of ulcer is justified. In this he suggests error he had made in being too definite, and very generally in the roentgenographic diagnosis of gastric ulcer his observations coincide with my own experiences.

As is well known to this audience, what is popularly designated as Haudek's niche is a departure from the normal continuous outline of the stomach shadow which is permanent in a considerable series of observations and which is not displaced or obliterated by palpation. You also know that such a characteristic departure may be temporary or transient, and when this is the case, it is not of significance. It is not our fault that gastric ulcer is too often diagnosed on a limited or incomplete observation, and that too often the phantom form is used to diagnosticate gastric ulcer when it is not present. But this leads us to a matter of more significance. May the phantom form, which is only a phenomenon of peristalsis, be permanent throughout the average length of time we use in the examination of the stomach, which is usually terminated in a six-hour session in the one person and the taking of about a dozen films? I am strongly inclined to the belief that this is so in some instances. There have been not a few cases,

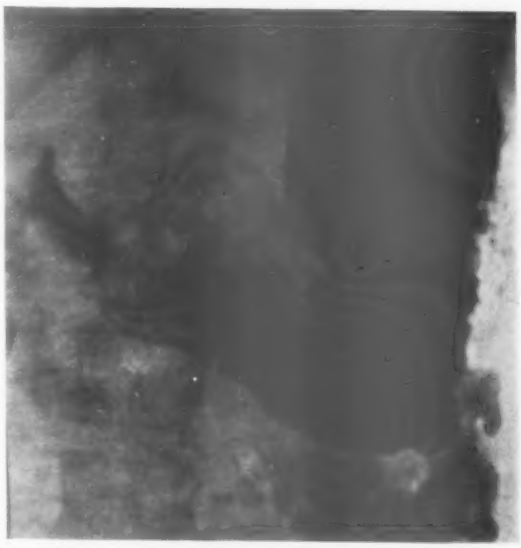

FIG. 1. Diagnosed as ulcer on roentgen-ray findings. No symptoms of ulcer. Stomach showed no lesion at operation (hysterectomy). Result satisfactory.

the films of which I have seen, with apparently a definite Haudek's niche throughout all of them, that were operated upon and on careful search no lesion was found. It is for this reason that I take leave to offer this for your consideration, so that you may devise some measures for the elimination of the error. Another point worthy of thought: In the last two years I have seen 9 instances of ulcer diagnosis in which more than two roentgen examinations were made (the shortest, one week intervening, the longest seven months, in which four examinations were made), and a Haudek's niche was constantly present in all and yet there was no ulcer. Logically, we may ask ourselves the question: "Is there not a peristaltic phenomenon in some stomachs which is normal in these

persons, and yet which is a Haudek's niche roentgenologically?" I feel quite sure that this must be so, and in a practice which like yours, is made up largely of referred work for diagnosis one cannot afford to have other than full cognizance of any very practical matter such as that which pertains to the accurate diagnosis of gastric ulcer.

Further, since much consideration of this subject is now found in medical literature, if there is any doubt about what some of us have granted as pathognomonically

FIG. 2. Diagnosed as gastric ulcer on roentgen-ray findings. No symptoms of ulcer. Treatment, cholecystectomy. No stomach lesion present. Result good.

diagnostic of gastric ulcer, even when clinical symptoms of ulcer are not present, then surely roentgenographic or roentgenoscopic observations showing its disappearance under medical treatment brings about some question of the accuracy of many of the favorable deductions that today are being broadcasted as proof conclusive of cure. In this you may refer to the literature of Caille and Montier,[34] Diamond,[35] Ohnell,[36] Einhorn,[37] Hamburger,[38] and Hollander.[39] May I add in this connection that I have had 27 instances of definite niche, three with gas bubble, which disappeared under medical treatment and on return of symptoms all of them were operated upon and large calloused ulcers observed. In addition to this, there have been a significant number of cases in which niches were present but which, in my belief, were not gastric ulcers, the defect on the lesser curvature disappearing upon treatment in which rest had a part. There have been at least fifty of these in the past two years, some being treated medically, others surgically. It would be very difficult for me to believe that any of them were instances of gastric ulcer.

Haudek's niche was and is seemingly accepted without question by roentgenologists, gastroenterologists and clinicians the world over as pathognomonic of gastric ulcer. It apparently was sufficient that Haudek drew attention to it for its accuracy to be taken for granted by others. This acknowledgment of Haudek was as complete and complimentary as was, and is, the merit of that worker in roentgenology. No real lover of the profession of medicine like myself would utter a word of opposition to such, for one of the sad things of the learned professions is that scientific advance is too often met by unfair criticism and unnecessary modification, or acknowledged by selfish plagiarism. Haudek was the first to draw full attention to a very valuable means of diagnosing

gastric ulcer, and his work in this regard was most signal and should be respected as such by all. Personally, we acknowledge to him and to the others a debt of gratitude, and we hope not to be misunderstood in this. Many have been the instances in which its presence has been of help in our work.

For a long time the presence of a permanent non-displaceable niche was sufficient indication that a gastric ulcer was positively present. After the fifth operation in which ulcer could not be found, I became more observing and watched this phenomenon with some interest. For the past two years I have not been so definite about it and in addition have required clinical symptoms of ulcer or persistent gastric trouble to be present. At a recent medical meeting,[40] during a discussion on ulcer treatment, many plates were displayed and the disappearance of the niche was used as proof conclusive of the value of a certain medical treatment. I ventured the statement that there might be error in the diagnosis or in testing the results of treatment, in which the niche alone was employed as the only or pivotal point of diagnosis and treatment. A very well known New York City gastroenterologist and others took critical issue with me, showing that they had taken this point for granted as I had formerly done. After a perusal of the literature on treated cases in which the presence of the niche made the diagnosis, and its disappearance was employed as proof of cure, I realized that a communication of caution on the subject was timely. Although my fellow clinicians were definite in their beliefs, it must be reported to the credit of our past president, Dr. William Stewart, who was present at the time, that he did not enter the discussion but quietly asked me at the close of the meeting to report my experience.

FIG. 3. Diagnosed as gastric ulcer on roentgen-ray findings. No symptoms of ulcer. Stomach found normal at operation for another condition (salpingectomy). Result good.

Since then we took each operated case that came along, and during the short intervening period between April 1, 1923 and July 1, 1923, we have collected reports and slides on 5 out of 39 cases of gastric ulcer seen.

The accompanying illustrations (Figs. 1, 2 and 3) show the folds on the lesser curvature which were erroneously interpreted as Haudek's niche.

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DISCUSSION[1]

Dr. L. G. Cole, New York. The president has asked me to open the discussion on these papers. I would like to talk on all three of the papers, but I am not going to. I am not going to say any more on the very able paper that Dr. Moore has presented. His conclusions, or the lantern slides, speak very finally for the diagnosis as he has given it.

So far as the paper on hour-glass contracture is concerned there is just one point that I would like to make. I like to make it every time I can; that is, that many of these cases of so-called spasmodic constrictions, spasmodic hour-glass constrictions, are called "spasmodic" because the surgeon doesn't find them, and they are considered not to be there. As a matter of fact, what happens is that the cicatricial contraction involves only the mucosa and the submucosa, which are drawn away from the serous coat and the mucosal and submucosal coats protrude as a narrow band into the lumen of the stomach. The surgeon looks at the outside of the stomach which is apparently normal in contour, especially when the stomach is empty, as it usually is when the patient is operated upon.

I wish to devote most of my time to a discussion of the third paper. I can't quite conceive what may be the object of that paper. One would have judged that it was proved that the roentgen examination is not accurate, that the presence of the niche is not conclusive evidence of a gastric ulcer. Well, now, I really expected that the writer would give us something of value, that he would show some of the difficulties in differentiating other defects from Haudek's niche, that he would show a jejunal diverticulum, or stones, the shadows of which protruded beyond the stomach, or sixteen other things which I have described on previous occasions and hope to get out some time, that will have to be differentiated from the niche. But there weren't any of those things at all.

Some *x*-ray man, I just like to call him an *x*-ray picture man, has interpreted those as a Haudek's niche. Well, now, I believe that the great majority of the men present here recognized the absolute absurdity of presenting to a national organization of this kind a paper like that.

I was present at the meeting where Dr. Bassler referred to this series of plates which had been demonstrated in Washington. We need not mention the man's name, but he came there with a series of plates that proved that some particular type of ulcer cure was effective. Now I had an opportunity, through the courtesy of the publisher of this Journal, to study those cases in detail prior to the meeting. I had an opportunity then to study them as they were presented, and there was only one of those cases out of that large series which this man quoted as ulcer cures in which there was roentgen evidence of an ulcer. And, therefore, I agree heartily with Dr. Bassler on that point. But I am surprised that he should have come here and shown us clear-cut

[1] This discussion has reference to the preceding papers by Drs. Moore and Doub, as well as to the above.

peristaltic waves which caught a particular passing cycle, show something which might possibly be interpreted as a crater. Is it possible that he really believed that those were ulcers, or did he just try to indicate that the roentgenologists were inexperienced?

Well, I didn't just get the gist of what he was trying to show, but I do feel that there wasn't a single one of those slides that showed an ulcer, with the possible exception of one, and of that there was a great deal of doubt. It would take serial roentgen examination of the various phases of the various cycles, and enough of them to make a diagnosis before one is justified in expressing an opinion, and in that type of case I would suggest the probability is we would have to repeat the examination in order to avoid errors.

Dr. W. H. Stewart, New York. As I feel some responsibility for the presence of Dr. Bassler here this afternoon, it might be well to tell "how it happened."

At a medical meeting last winter Dr. Bassler made the very radical statement that a Haudek niche did not always indicate ulceration. He stated he was confident of this fact but was not prepared at that time to prove his statement so I suggested that he come out to the next meeting of the American Roentgen Ray Society and tell us about it, so he is really here at my invitation; that perhaps will answer Dr. Cole's question.

Dr. Bassler has not proven his point. His paper should have been entitled "The Misinterpretation of Haudek's Niche," as all of his cases were misinterpreted. I feel very positive that if the Haudek niche is present, it *does* indicate ulceration.

Now, gentlemen, don't depend entirely upon your budding. Dr. Cole taught us many years ago that in the interpretation of an excavating ulcer, you must not only have the budding appearance, but the flattening around the protrusion as well.

Dr. Bassler's reference to the roentgen examination as indicating the amount of healing in an ulcer is extremely interesting. We have been able to show great variation in the size of the ulcer shadow within a few days; sometimes it will disappear entirely, probably due to the crater filling with food or mucoid substances, so that one may well hesitate to accept the roentgen findings alone as indicating the healing of an ulcer. If, however, the ulcer crater, as shown roentgenographically, persistently and progressively diminishes in size and this contraction is supported by a corresponding improvement in the clinical manifestations, then one can, with reasonable security, feel that the ulcer is healing.

Dr. Gray, Richmond. I was very glad indeed to hear Dr. Stewart refer to the fact that clinicians have been attempting to use roentgen-ray methods to prove the healing of ulcers.

We have seen published in the medical literature in various portions of this country demonstrations of medical healing of ulcers. I have been asked time and again to "please examine this patient, and see how this ulcer is coming on, which you discovered a year ago," or "six months ago." Invariably I tell the clinician that I can give him practically no information as to whether or not this ulcer has healed. If, perchance, it has been a superficial ulcer, especially one involving the bulb of the duodenum, and the ulcer has so healed as not to leave any cicatricial contraction or any adhesions, then we can say that in all probability the ulcer has healed. But how often do we see that? I think all of us should take the position that we cannot tell whether or not an ulcer is healing except in those very rare cases mentioned.

Dr. L. T. LeWald, New York. I would like to show a slide that will illustrate a type of deformity of the stomach due to perigastric adhesions, which I am not sure that Dr. Doub particularly mentioned, but might be mistaken for an organic lesion of the stomach. In this case there had been a previous operation, exploration on the gall-bladder, and following that the patient had gastric symptoms, and on operation there was found the very definite restricting band across the stomach, over to the gall-bladder region. Now the differential diagnosis in this case could be made, because there was a shifting of the narrowed parts of the stomach, although the latter remained about the same width. In case one gets a shifting deformity of the stomach of that sort, he might possibly diagnose perigastric adhesions as the cause of the phenomenon.

Now I think Dr. Doub left the impression, possibly, that mediogastric resection was not an advisable operation as a rule. I would like to state that in about 30 cases which we have followed after operation, where mediogastric resection has been done, there has been perfect functioning of the stomach. We have a case like one which he showed, in which there was not good functioning of the emptying of the stomach. In that case a second operation was performed, and a pyloric stenosis relieved which had been present at the time of the first operation but not recognized. I think the operation is a very good one in the hands of a surgeon who is experienced in the use of the operation and uses excellent judgment at the time of opera-

tion as to whether he can, in a short time, make a successful closure of the wound.

The next case is one of an extremely deformed type of stomach—a trifid stomach. It is about the only one in the series of hour-glass stomachs lost after operation. There was a very complicated deformity, in which the question of a gastrogastrostomy was discussed, but at operation that was not performed on account of the extensive perigastric adhesions, and a loop of intestine was brought up and placed at the upper pouch. That loop of intestine unfortunately proved at the autopsy, which occurred about a week later, to be the ileum. That might have been avoided if sufficient attention had been paid, possibly, to the roentgen-ray interpretation. In the report it was stated that a portion of the meal at the six-hour period was up in this region, indicating that ileum might be present in that region.

Dr. Moore's paper is exceedingly interesting. We had one case of food retention that very closely simulated gastric polyposis. In fact, the clinician in that case who came into the laboratory before I saw the plate made such a diagnosis, but he was very willing to reverse his findings when I insisted that he wash the stomach out, and when we repeated the procedure, the appearance of polyposis had disappeared.

The dragging into the duodenum of the large gastric polyp was interesting. It is very similar to a case of carcinoma of the ileocecal valve in the exhibit room, in which the small intestine was dragged in and made an intussusception.

Dr. Bassler's cases, I am sure, were brought out largely on account of the discussion in regard to the question of the healing of ulcers. At least that is what I expected would be the discussion, and it is curious that a case which shows a definite niche cannot always be demonstrated a short time later. I know two or three cases like that. And even his contention that peristaltic waves may simulate an ulcer crater is not so far-fetched. I have known cases in which it did very closely simulate it, the niche-like deformity being quite constant. The point that was brought out just a moment ago is very true indeed, that if accompanying signs are absent, such as induration, or the spasm opposite, one has to be exceedingly cautious in making a diagnosis.

Dr. Bettelheim. Most of the conditions which can imitate a niche were known to Haudek shortly after the discovery of the "niche" symptom. They are mostly jejunal coils which when lying on the smaller curvature will be interpreted as "niche;" when on the major curvature as "niche" or diverticulum of the stomach. But most of these diagnoses will be made from plates made by the technician when the roentgenologist did not even see the patient. Technicians have a very defective idea of the way that the niche originates. Haudek himself does not trust to make the diagnosis of niche from an *x*-ray plate for the simple reason that the picture seldom discloses anything about the origin of a shadow. You know that the discovery of the niche symptom was made by a school which uses mostly fluoroscopy for *x*-ray diagnosis; and, like its discovery, so the correct interpretation of it is not possible without the use of fluoroscopy.

We must see from which organ and from which source the shadow comes. Shadows of concrements in the kidneys, pancreas, mesenteric glands and the intestinal wall have their characteristics also on the plates, but they will be recognized with certainty only when they are localized on the plate, or even better, on the screen before the stomach has been filled. The coils of small intestine filled with contrast material have characteristic outlines also on the plate on account of Kerkrings folds, but we can see with more accuracy on the screen the contrast meal being pushed forward in the intestine and before this stage how the outlines of the stomach can be discerned in every direction under the fluoroscope. This is the only method of examination that assures us whether the shadow originates in the stomach or in the duodenum. After all the intestines are filled, even the anatomical orientation becomes extremely difficult, as is known by all who practiced the examination of postoperative stomachs. Coils of intestines containing gas can also throw peculiarly outlined shadows, as is also known to all by personal experience.

The traction diverticula caused by perigastric adhesions can be distinguished from the niche shadow with much greater difficulty, but this should be not of too great importance if we consider that the circumscript perigastritis is mostly the consequence of an ulcerous disease of the stomach wall.

I have but to mention that an eventual bulging out of the stomach shadow may occur on account of the anatomical structure of the wall of the stomach, especially distally from the cardia and angulus ventriculi on the smaller curvature.

Thus the niche symptom remains the most valuable and certain *x*-ray sign of ulcer of the stomach or duodenum when carefully examined and interpreted.

Dr. Gottlieb, New York. Last spring it was my privilege to attend the German *X*-Ray Clinic in Munich, and a paper was presented which was very similar to that of Dr. Bassler, and it aroused a great deal of discussion.

Another gentleman prepared a paper in which he proved that he could produce the niche, make it disappear, and produce it again in the same day, and Dr. Haudek then admitted himself that a bulge, a persistent, teat-like bulge, on the lesser curvature is not always an ulcer; he didn't know just how to differentiate it, he has found a number of cases like that, and I really thought Dr. Bassler was in collusion with him when I heard the paper.

Dr. Bassler (closing). When I read that paper I really couldn't help but smile, because I left myself so open to criticism in a way.

But nevertheless, gentlemen, it is true that diagnoses of ulcers are being made on a simple bulge on the lesser curvature. And I would say that I think you gentlemen who represent this national organization should use the terms "true" and "false" niches. There seems to be a great laxity in this, and those two terms would help to clear it up.

Another thing,—the literature on niches is brought together in this article,—and we, after writing to the various prominent roentgenologists throughout the world and getting answers, found that they knew of one paper by Haudek and one paper by So and So, and that there are really 47 papers in the literature of the world on the niche,—I thought that it was time somebody did that. Haudek himself admits to 5 per cent of failure, back as far as 1910. I admit to about 10 per cent of failure in definite niches, no ulcer being present. We take about 15 films of every stomach. I feel definitely as a clinician who has an expert roentgen department, that unless there are some symptoms of stomach trouble, I hesitate to make a diagnosis of ulcer on the niche alone, and I admit to not being clever enough with my fingers, and otherwise, to tell always that there is a callus surrounding it.

I feel that this Society likewise should teach the dictum to clinicians that the absence of this bulge is not proof conclusive that the ulcer is cured. I am seeing the fallacy of this all the time, and I am very glad that in the discussion this point was again brought out.

I am sorry that Dr. Cole has taken that position. He is so serious about everything that he didn't at all catch the point of my contribution. What I wanted to bring out to you is this, that diagnoses of ulcers are being made on these bulges that are not true niches and they are sending them in to me and to surgeons as ulcers on that simple bulge. Tests of medical cures are being proven on the bulge present at one time and not there at a future time. And I again ask you to make it your business that a true distinction be broadcasted between false and true niches, because if I have done nothing else today but that, I feel that I have rendered a service,—a crying need in the roentgen diagnosis of this thing today, as it is being carelessly conducted, at least in my part of the country, which is New York.

Dr. Doub (closing). My paper was not primarily in regard to spasmodic types, so I will say nothing more about that.

With regard to the question Dr. Cole brought up, I will say a word concerning the sleeve resection operation which I gave the impression of condemning. I think that that probably is a very good operation, providing there is a competent surgeon doing it, and providing the patient is in sufficiently good physical condition. Unfortunately, in some places patients are operated upon without putting them in the proper physical condition. I believe if a patient were hospitalized, or put under very good medical management, and in good condition, possibly that operation would be applicable to a much larger percentage of cases than the more simple operation of gastrogastrostomy or gastroenterostomy.

An educated man knows when a thing is proved and when it is not. An uneducated man does not know. Lord Morley.

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TWENTY-FIFTH ANNUAL MEETING
To be announced

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Fifth Annual Meeting
Atlantic City, N. J., Jan. 24–26, 1924.

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Fifth Annual Meeting
Indianapolis, Ind., Feb. 23, 1924.

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To be announced

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NINTH ANNUAL MEETING
To be announced

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Collaborating Editors: The Officers and Committee Members of the Societies of which this JOURNAL is the official organ, whose names appear on the preceding page, are considered collaborating editors of this JOURNAL.

Foreign Collaborators: A. BECLERE, M.D. G. F. HAENISCH, M.D. ROBERT KNOX, M.D. R. LEDOUX-LEBARD, M.D.

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Information of interest to all readers will be found on page i. Lists of officers of The American Roentgen Ray Society and The American Radium Society will be found on page preceding Editorial Section.

PLANS FOR THE FUTURE OF THE JOURNAL

THE AMERICAN JOURNAL OF ROENTGENOLOGY AND RADIUM THERAPY enters, with this issue, upon a new era, in that it will henceforth be greatly enlarged and will be published in two volumes annually instead of one.

The larger size of the JOURNAL makes it necessary to increase the subscription price, and in this connection we wish to bring to the attention of our readers certain considerations with regard to the value of the Journal.

The new editor has already received criticisms of the JOURNAL like the following: "Please discontinue my JOURNAL; it contains entirely too many radium articles." Another writes, "Discontinue my Journal. I am interested in therapy and find only diagnostic articles in it." Another writes, "The Journal is entirely too 'high-brow'"; while still others have suggested to the editor that he really must raise the scientific standard of the articles.

These comments seem to the editor to indicate an extremely narrow view of the place to be filled by medical journals in general and by ours in particular.

Medical literature may be divided into two classes: First, that which is of immediate and perhaps only temporary value and which should be read in its entirety; second, that which is in the nature of research and is of value only for reference.

THE AMERICAN JOURNAL OF ROENTGENOLOGY AND RADIUM THERAPY hopes to make a definite place for itself in both of these branches. The articles which today are passed over as of no practical worth may be the very ones which will give to the JOURNAL files their permanent value and make them invaluable for reference in the future.

What applies to this journal applies, after all, to every branch of medicine. What we wish to emphasize is that a medical journal is not to be placed in the class with the daily newspaper, which is discarded as soon as read. The medical journal is even more justly entitled to a permanent place in every medical library than are the textbooks which become out of date and are replaced by new ones almost from year to year. Medical periodicals are the backbone of the public medical libraries and are the original sources from which textbooks are compiled. The roentgenologist, therefore, who reads what he finds of immediate interest when his journal arrives and then carefully files it to be bound with its index when the volume is complete, will soon find that he possesses a valuable reference library on roentgenological subjects.

It is the editor's care to have in each number at least *one* article of interest to all readers. To make every page of every number of equal interest to every reader is a Utopian dream that the editor does not hope to realize.

It may not be amiss, therefore, to point out to our readers that books of the size

of a volume of the JOURNAL would cost more than an annual subscription to the JOURNAL. We fully believe that the reading done from month to month will be of more value than the subscription price, and that the large amount of material so valuable for reference is really a "bonus" received with the subscription.

In carrying out the new plans for the JOURNAL the editor very earnestly asks the support and help of all the old subscribers, and hopes that the JOURNAL will attract to become its supporters a large number who have not heretofore realized its value in their work.

DR. H. M. IMBODEN OUR RETIRING EDITOR

The following resolution was passed at the Twenty-fourth Annual Meeting of The American Roentgen Ray Society:

"Five years ago the American Roentgen Ray Society, realizing that the continuance of its official publication was a necessity for the best interests of the society, and with the full knowledge that the editor was the most important factor in maintaining the high standard of its publication, chose Dr. Harry Imboden as editor-in-chief.

"The continuance of the high standard of the articles selected and published, the progressive growth and the attainment of the enviable position of the American Journal of Roentgenology, so that it has come to be regarded as the leading journal in the roentgen publications of the world, has shown the wisdom of this choice.

"With a full realization of their debt, the members individually and collectively extend to Dr. Imboden their thanks and appreciation of his valued work, characterized by untiring efforts and conscientious sacrifices.

"In order to perpetuate this appreciation, it is resolved that these words be spread on the minutes of the meeting and that an engrossed copy be sent to Dr. Imboden."

This resolution indicates in only small measure the respect and affection in which Dr. Imboden is held by the members of The American Roentgen Ray Society. Everyone remembers that he assumed the duties of Editor of the JOURNAL in a sudden emergency during the World War and that he maintained during that trying time the high standard set for it by its previous editors.

The members of the Society wish to make public acknowledgment of their gratitude to Dr. Imboden for the service that he has so rendered, and also of their appreciation of the sacrifices entailed by his duties as editor.

THE CALDWELL LECTURER FOR 1923

We are publishing in this issue a portrait of Dr. Percy Brown, one of the oldest members and a former President of the American Roentgen Ray Society, and one of the pioneer roentgenologists of this country. He was the Caldwell Lecturer for the year 1923. It seemed particularly appropriate that one who was a close personal friend of Eugene Caldwell and who has suffered in the same cause, should have been chosen to deliver this lecture, which is given annually in honor of one of the martyred members of our Society.

It gives us great pleasure to make it possible for Dr. Brown's many friends to secure this excellent portrait.

RADICALISM VERSUS CONSERATISM IN RADIUM THERAPY

The history of medicine is full of examples of the universal law of action and reaction. Only a few years have elapsed since surgeons were wont to concentrate their attention on the lesion and to direct their efforts towards its eradication, while the patient received scant consideration. Excessive mortality rates soon forced the more radically minded to change their tactics, and common sense is now in a fair way of being restored.

During its relatively short existence radium therapy has passed through much the same, though somewhat attenuated, phases. However, it is now generally recognized that to cure the lesion and kill the patient is neither advancing medical science nor contributing to the sum of human happiness.

The decision as to how radical the treatment in a given case should be must depend on the condition of the patient quite as much as on the character, size, location and distribution of the lesion

treated. For instance, in carcinoma of the cervix, careful general examination will usually enable the radiologist to classify such cases into two main groups: (1) those in whom anything approaching cure is out of the question, and (2) those in whom permanent cure may conceivably be expected.

In dealing with patients in the first group the object must be to obtain the maximal degree of improvement possible, while avoiding any measure that may sap the patient's strength or increase existing disability. This object is best fulfilled by adopting a conservative course.

In patients of the second group reasonably radical measures are indicated. It is well known that unless all the cells of a malignant tumor receive a lethal dose at the outset, some of them will in time recover their power to grow and ultimately will kill the patient; the initial attack must therefore be carefully planned and thoroughly executed. Unless the technique be sound and the first attempt at treatment thoroughgoing, no amount of subsequent therapy will yield the result that might otherwise be obtained.

The same principle applies to malignant lesions elsewhere in the body. To be effective, every therapeutic measure must be based on intelligent understanding of the lesion against which it is directed. "Shot-gun radiology" is no better than the "shot-gun" prescriptions in common use twenty years ago.

As roentgenologists, many of us have allowed ourselves to become so engrossed in the study of shadows that we have all but lost the sense of reality. Recent increments to our knowledge of the physical aspects of roentgenology have caused many of us to direct so much attention toward physics that we have almost forgotten that we are primarily physicians. It is a fact, however, that physical knowledge in the roentgenological field has far outdistanced our knowledge of the pathological conditions in which radiation is therapeutically employed. For the time being it would seem that physics may safely be left to the physicist while we resume the study of pathology and clinical medicine.

A. U. Desjardins, M. D.

RADIATION TREATMENT OF CANCER

Since the action of the roentgen rays upon new-growth cells was first observed, continuous efforts have been made to treat successfully various forms of cancer. The degree of success achieved has varied with different workers.

Quite recently the treatment of cancer by the roentgen ray has received fresh stimulus from the published results of several workers on the European continent, and all over the world roentgenologists have tried to repeat these results, using in many instances the same form of apparatus and tubes, and as nearly as possible the same technique as that described by the continental workers. In view of the conflicting opinions held by many roentgenologists and clinicians, the present is an opportune time to review the questions of radiation treatment of cancer and other forms of malignant growth.

The discussions on this subject at the annual meeting of the American Roentgen Ray Society last September showed a tendency toward caution rather than optimism. This indicates the inevitable recoil following upon the extreme optimism initiated and sustained by the publication of results claimed to have been made by several workers on the Continent of Europe. It also indicates that time enough has already elapsed for many workers to try the newer techniques, and to ascertain for themselves the value of the treatment.

There can be no doubt that the hope of curing cancer by the more intensive treatment made possible by the production of more powerful apparatus and of tubes capable of sustaining the high potential current induced many workers to enter the field and to treat cases with greater enthusiasm than judgment, the consequence being that disastrous results often ensued.

The fact stands out clearly that a great advance in technique has been made, and it would be unfortunate if the value of this advance should be lessened by the misguided enthusiasm of inexperienced workers. Such results seem usually to follow the advent of a new therapeutic agent, or the improvement of an existing

one. Koch's discovery of the tubercle bacillus and a serum to combat it led to equally extravagant hopes, which in the subsequent development of the method were not realized. The introduction of salvarsan led to great hopes in the treatment of syphilis, many of which have not been fulfilled; and disasters were not uncommon in the earlier exploitation of the method.

The appearance of any treatment claiming to be a cure for cancer cannot but be subjected to the same alternating fluctuations of hope and despair. Let us, therefore, be very guarded in the expression of views which at present can only be speculative. A disease whose cause is as yet undetermined, in all probability cannot be cured by any treatment which is founded upon empiricism.

Until we know more of the intricate changes in cell growth, it will be useless even to contemplate the possibility of a specific cure for cancer. A great deal of experimental work must yet be done before the biological processes of cell growth can be understood.

It is apparent that in the study of cell growth, radiations may help materially to clear the ground for further great advance. It is significant that a number of the leading cancer research workers are turning their attention to the biological processes in an endeavor to elucidate the problem. Of these the works of Fibiger, Leitch, Murray and Drew are particularly interesting. Drew's observations in relation to tissue changes occurring in cultures in vitro are of special interest to the radiologist. He concludes a paper with the following:

"The activating substances in autolyzed extracts of normal adult tissue and their absence in embryonic tissue extracts shows that they are undoubtedly the same agents which are met with in the phenomena of repair. Their presence in cold extracts of the malignant tumor suggests that it is by means of a continuous production of these substances that tumor growth is maintained and constitutes a new and very striking difference between tumors and normal tissues, the former containing the growth-stimulating factors, while the latter require to be severely damaged before they are produced. The fact that the highly malignant and rapidly growing tumors contain a far greater amount of such growth-activating substances than do the slowly growing and more benign, reveals a quantitative relation, which has not before been demonstrated in the analysis of tumor growth."

In regard to the growth of a culture of sarcoma, he makes the following significant observations: "It is evident that 37 S in culture produces some substance which is toxic to itself, and can inhibit growth in vitro; this substance is evidently not toxic to culture of heart cells. Heat at 60°C., for half an hour, destroyed its toxicity."

Observations such as those of Drew, Murray and Leitch on the process of development of tumors indicate the lines upon which observations on radiation effects should proceed, and point to the need of extreme caution in the handling of agents which are likely to interfere seriously with the natural processes of repair.

The patient should be the first consideration in all attempts at cure by radiations or allied measures. Treatment should be made on rational lines, which are evolved from a consideration of physiological and pathological processes. If a very long exposure is contemplated, then all steps should be taken to ensure that the patient is in a fit condition to stand the strain. A careful consideration of the pathological processes at work, the condition of the tumor, the type of cell composing the bulk of its structure, and also that of the surrounding tissues, will in a number of cases rule out at once any hope of a cure. The treatment must then become palliative, and in this group there is a large field for the roentgenotherapist.

In an inoperable case of cancer combined treatment is the most rational procedure, and in such a combination it will be found that the use of the diathermy current is invaluable. Many cases, apparently hopeless from the point of view even of relief, have made startling progress, when treated rationally by an experienced roentgenologist. Radium and roentgen rays are very valuable adjuncts to diathermic cauterization. The latter agents in carcinoma of the cervix often give most brilliant results

when either alone will fail. Radium is the best agent we possess for the local treatment of the disease.

The successful treatment of malignant disease requires a much more comprehensive regime than that of radiation alone. Much of the value of the treatment by such means is lost by the failure to realize that we are dealing with a patient and not with a purely physical problem. Dietetic and drug treatment are of value, and above all the environment of the patient must influence all effort to cure him. Combined treatment is clearly indicated in many of the cases of malignant disease, and such treatment must include the cooperation of the surgeon and the radiologist. The former, by a modified operation, will in many instances greatly add to the prospect of relief or cure, while in the technique of radium therapy a most complicated operation may be the necessary precursor to the insertion of radium tubes into the substance of a growth. Again, after radiations and other methods have accomplished all that is possible, the surgeon may by a plastic operation complete the cure.

Preoperative and postoperative treatment will also have a profitable place in the treatment of malignant disease. It is apparent that with the ordinary technique of roentgen therapy in its application to the treatment of disease, great skill is necessary before even temporary results are obtained. Skill without judgment in application is useless, and the exercise of the latter demands a most thorough knowledge of all the factors, and of the probable effects upon the living organisms.

We would urge most insistently that an estimation of the value of the so-called "deep therapy" can only be arrived at after most exhaustive research work in all directions. Such work will necessitate the collaboration of many experts in the various fields of research.

ROBERT KNOX, M.D.

SUGGESTIONS FOR ADDITIONS TO THE ROENTGENOLOGIST'S LIBRARY

The rapid developments in the field of roentgenology and radium therapy are making it increasingly important for the radiologist to have the preliminary education and training, the wide clinical experience and the general culture that comes from reading, that are necessary in the development of every broad-minded physician.

The radiotherapist who hopes to be more than a mere technician must have a thorough knowledge of the pathological anatomy and the usual clinical course of the diseases he treats, and, moreover, must keep thoroughly informed of advances in knowledge of these diseases. This necessitates constant studious reading.

No one who is treating cancer by whatever means, can afford to neglect reading the second edition of Handley's book on "Cancer of the Breast and its Treatment," which is reviewed in this issue of the Journal and which Knox quotes in his article, also published in this issue. We recommend also the book of Bland-Sutton on "Tumours Innocent and Malignant. Their Clinical Character and Appropriate Treatment" (reviewed on page 95 of this issue). Other books that, in our opinion, should be in the library of the radiotherapist are "Neoplastic Diseases" by Ewing, "The Breast; Anomalies, Diseases, Treatment" by Deaver and Macfarland, and "Radium Therapy" by Simpson. The latter was reviewed in the JOURNAL for June, 1923, p. 458.

Subscribers to THE AMERICAN JOURNAL OF ROENTGENOLOGY AND RADIUM THERAPY *visiting New York City, are invited to make the office of* THE JOURNAL *(69 East 59th Street, New York) their headquarters. Mail, packages or bundles may be addressed in our care. Hotel reservations will gladly be made for those advising us in advance; kindly notify us in detail as to requirements and prices. List of operations in New York hospitals on file in our office daily.*

SOCIETY PROCEEDINGS, CORRESPONDENCE AND NEWS ITEMS

ANNUAL MEETING OF THE SOUTHERN MEDICAL ASSOCIATION, Washington, D. C., Nov. 12–15, 1923.

The annual meeting of this association is one of the largest and most important medical gatherings in this country. There were over twenty-three hundred registrations at this year's session. The President of the Association, the Section Chairman and others who assisted in arranging the program and the local committee of entertainment all deserve great credit for a most successful meeting.

The first General Session at this meeting was notable for inspiring and instructive addresses and orations, among which were the President's address on "Modern Problems of Preventive Medicine" by Dr. W. S. Leathers of University, Miss., and an address by Dr. George E. Vincent, President of the Rockefeller Foundation, on "Medicine as an International Influence."

At the concluding General Session Dr. Charles Minor of Asheville was elected President of the Association for the ensuing year.

The scientific program is conducted by nineteen different sections and subdivisions and an attempt will be made here to summarize briefly the work in the different sections that is of especial interest to roentgenologists and radium therapists.

The Radiological Section met on two succeeding afternoons under the chairmanship of Dr. David Y. Keith of Louisville. Dr. Keith in his Chairman's Address spoke on the subject of "Roentgen Aid in the Acute Abdomen," and emphasized especially the diagnosis of acute obstructions, diaphragmatic hernia and subphrenic abscess. Dr. Robert H. Lafferty read a comprehensive paper on the roentgenology of the urinary tract, and Dr. John J. Shea of Memphis, Tenn., presented a very interesting paper on the development of the nasal accessory sinuses in the embryo and infant, followed by a discussion of the value of roentgenology in the diagnosis of sinus diseases in the child and adult. He showed especially the value of roentgenograms as a guide in operations on the sinuses. The second session of the Radiological Section was given over to papers on roentgen therapy. Dr. Howard E. Ashbury gave an instructive paper on "A Practical Method for the Application of *X*-Ray Dosage." Dr. E. C. Ernst, in a paper on "The Management and Measurement of *X*-Ray Radiation in Deep-Seated Malignancies," gave some recent dosage methods, with comparison of effects with different filtration. Dr. J. M. Martin showed the curative effect of the roentgen ray in malignancies of the face by often-repeated doses through moderate filtration, and Dr. S. S. Marchbanks of Chattanooga gave a good paper in which he emphasized the necessity of keeping in mind the fact that radiation not only has an effect on the malignant disease but that it also has a general effect on the patient which may defeat all our well-intended efforts; the welfare of the patient must be the first consideration rather than simply the cure of his malignant disease.

The Radiologic Section at its final session elected Dr. W. R. Bethea of Memphis, Tenn., as Chairman for the ensuing year.

The Southern Gastroenterological Association meets as a section of the Southern Medical Association, and at its sessions were presented addresses and papers of much interest to roentgenologists. Dr. F. H. Baetjer gave an address as a part of a Symposium on Intestinal Stasis on the subject "The Roentgen Ray in the Diagnosis of Chronic Intestinal Stasis." He emphasized the fact that the clinical significance of the roentgen findings in any given case must be interpreted with the help of a knowledge of the habitus of the patient. A delay which might be of significance in a patient of the sthenic type would be negligible in a person of the asthenic type. Dr. Russell Verbrycke read a paper in this section on "Chronic Duodenal Stasis," giving, among the causes of this condition, aberrant blood vessels

causing angulation, adhesions of the duodenum arising from the gall-bladder, congenital veils and adhesions, etc. Dr. E. C. Samuel read a paper on "Deep *X*-Ray Therapy of Peptic Ulcer" in which he cited the fact that numerous papers have been published during the past year, especially in the German literature, which recommend roentgen therapy for the treatment of gastric and duodenal ulcer. He shows convincingly by a report of such cases treated by him according to the published technique, and subsequently operated upon, that the roentgen treatment has no curative effect.

The Section on Bone and Joint Surgery had many interesting papers, nearly all of which were illustrated by roentgenograms. We hope to publish a special review of these papers in a future number of the Journal.

At the meeting of the Southern Medical Association last year and again this year the Surgical and Radiological Sections had a joint dinner followed by addresses on a subject of interest both to surgeons and radiologists. Last year the subject was "Hyperthyroidism" and Dr. G. W. Crile presented the surgical side of its treatment and Dr. George Holmes discussed its radiological treatment. This year the subject was "Radiation in the Treatment of Cancer of the Breast with Special Reference to Radiation Before and After Surgical Operation." Dr. W. E. Sistrunk of the Mayo Clinic presented the subject from the surgeon's standpoint and Dr. George E. Pfahler from that of the radiologist.

Dr. Sistrunk said that in early cases, without glandular involvement, radical operation cures about 64 per cent of the cases operated upon but that after axillary gland involvement they had had only 19 cures out of 132 cases. He emphasized the necessity for extending the time for reporting cures to five years or even more because of the considerable number of cases that recur up to and even beyond five years. He recommends both preoperative and postoperative radiation of breast cancer but is not prepared to say just how soon radiation should be given after operation. He does not believe that radiation treatment results in complete cure of breast cancer, and he showed several slides illustrating this point. Some of these were photographs of patients with local recurrence and metastases after thorough radiation, and others were photographs of removed breasts showing cancer still present surrounded by fibrous and hyaline changes. He referred to McCarthy's work in which he had shown that at the periphery of a growing carcinoma there is a zone of fibrous and hyaline changes, and leucocytosis. He believes that radium and the roentgen ray may exert their beneficial effect by simulating nature's method, since it is known that the rays do produce these effects.

Dr. Pfahler called attention at the beginning of his address to the fact that the types of breast carcinoma which are easiest to deal with surgically are likely to be those most resistant to radiation treatment; the medullary type of cancer may yield readily to radiation while the scirrhous type is usually very resistant. He also referred to experimental work that has definitely proven that radiation of carcinoma before it is inoculated into healthy animals prevents its growth in a large majority of instances, and to other experiments which show that radiation of animals before the inoculation of unradiated carcinoma will also prevent the growth of the carcinomas. These two sets of experiments furnish conclusive proof that irradiation not only has a deleterious influence upon the cancer cells but that it also has some influence upon the healthy tissues which prevents the tumor growth. Dr. Pfahler presented a great number of cases illustrated by lantern slides which showed in a very convincing way the value of irradiation not only as a preoperative and postoperative measure, but as the sole treatment in inoperable cases.

Both of these papers and also those mentioned previously in this brief review will be published later in the Southern Medical Journal and abstracted by us.

PRELIMINARY PROGRAM OF MID-WINTER MEETING EASTERN SECTION A.R.R.S.

CHALFONTE-HADDON HALL, ATLANTIC CITY, N. J., JANUARY 24, 25 AND 26, 1924.

THOMAS A. GROOVER, M.D., *President*

Experimental Studies on X-ray Effects. James B. Murphy, M.D., New York.

The Diagnosis of Primary Intrathoracic Neoplasms. Geo. F. Thomas, M.D., and H. L. Farmer, M.D., Cleveland.

A Stereoscopic Film Changer for the Upright Thoracic Position. Especially Designed for the Rapid Handling of Heavy Cassettes and Embodying Other New or Hitherto Little Used Principles. David R. Bowen, M.D., Philadelphia.

Lateral Roentgenography of the Lumbosacral Region. L. T. LeWald, M.D., New York.

Atelectasis as a Roentgen-Ray Sign of Foreign Body in the Air Passages. W. F. Manges, M.D., Philadelphia.

Case History—Fibroid Goiter Completely Cured by X-ray through Open Wound. Previous Diagnosis of Malignancy. W. E. Reilly, Clearfield, Pa.

The Roentgen Ray in the Treatment of Cellulitis and Other Acute Lymphangitic Infections. F. M. Hodges, M.D., Richmond Va.

(*Title to be announced.*) William Duane, Ph. D., Boston.

(*Title to be announced*). R. H. Stevens, M.D., Detroit.

Blood Types in Relation to Carcinoma and Its Treatment by Radiation. G. E. Pfahler, M.D. and B. P. Widmann, M.D., Philadelphia.

The Study of the Sternum by Roentgen Rays (*Lantern Slides*). G. E. Pfahler, M.D. Philadelphia.

Roentgen-Ray Treatment of Keloids. H. H. Hazen, M.D., Washington.

Roentgen Findings in Some Unusual Lesions of the Gastrointestinal Tract. W. H. Stewart, M.D., New York.

(*Title to be announced.*) Burton J. Lee. M.D., New York.

Description of Fracture Tables. H. K. Pancoast, M.D., Philadelphia.

Preliminary Report on the X-ray Treatment of Amoebic Colitis and of Wassermann-fast Lues. Samuel Stern, M.D., New York.

X-ray Study of a Case of Leukosarcoma (*Sternberg*). Sherwood Moore, M.D., St. Louis.

Two-minute Demonstration on Use of Ryan's Rule—A Convenient Instrument for Treatment. A. H. Pirie, M.D., Montreal.

Radiography of the Mastoid Process. Isaac Gerber, M.D., Providence.

Cases of Chronic Tonsillitis and Pharyngitis in Which X-ray Therapy is Indicated. W. H. Witherbee, M.D., New York.

The Differential Diagnosis between Cardiac Enlargement and Pericarditis with Effusion (*Slides*). Berton Lattin, M.D., and C. Winfield Perkins, M.D., New York.

A Brief Report of Two Urological Cases. R. H. Lafferty, M.D., Charlotte, N. C.

The Value of Deep X-ray Therapy in the Treatment of Carcinoma of the Bladder. Chas. A. Waters, M.D., Baltimore.

Diagnosis of Aneurysm of the Aorta. E. C. Samuel, M.D. New Orleans.

Mixed Radiation in the Treatment of Neoplasm, with Report of Cases. D. Y. Keith, M.D., Louisville.

Lung Tumor with Symptoms Referable to the Right Upper Quadrant of the Abdomen. H. M. Imboden, M.D., New York.

Some Considerations in the Treatment of Carcinoma of the Esophagus. Douglas Quick, M.D., New York.

Massive Collapse of the Lung. Geo. W. Holmes, M.D., Boston.

(*Title to be announced.*) John Remer, M.D., New York.

(*Title to be announced.*) H. J. Walton, M.D., Baltimore.

Roentgen-Ray Studies in the Feeble Minded. M. W. Clift, M.D., Detroit.

Palliative Doses of X-ray in Advanced Cancer. Eugene Leddy, M.D., and J. L. Weatherwax, Ph. D. Philadelphia.

Traumatic Hernia of the Diaphragm. F. F. Borzell, M.D., Philadelphia.

Deep Therapy and Radium in Carcinoma of the Tonsil. G. W. Grier, M.D., Pittsburg.

The Role of Ligamentous Calcification in Lower Back Pain. Howard P. Doub, M.D., Detroit.

Further Studies of X-ray Penetration (to be read by title). J. L. Weatherwax, Ph. D., Philadelphia.

A Practical Method of Constantly Measuring the Radiation from an X-ray Tube with a Check against the Omission of Filters. J. L. Weatherwax, Ph. D., Philadelphia.

A Case of Hodgkin's Disease with Late Developments of Sacroiliac Disease Cured by X-ray Treatment. C. P. O'Boyle, M.D., Philadelphia.

Treatment of Bone Sarcoma—Case Report. Myron B. Palmer, Rochester, N. Y.

The Roentgenological Diagnosis of Craniopharyngeal Pouch Tumors. K. G. McKenzie, M.D., and M. C. Sosman, M.D., Boston.

The X-ray in the Treatment of Bone Tumors. R. E. Herendeen, M.D., New York.

MEETING OF CENTRAL SECTION

The Central Section of the American Roentgen Ray Society will meet at Indianapolis, Ind., Feb. 23, 1923. Members having new developments to present will be given opportunity at that meeting.

All subscribers of the JOURNAL, and those interested in roentgen work are invited to attend.

The program is well under way, and will include morning, afternoon and evening programs. A lantern-slide exhibit will be held at the evening meeting with film demonstrations of interesting cases. This should be more profitable than the lantern-slide show. For further information in reference to the program please write:

Dr. D. Y. Keith, Louisville, Ky., Chairman.
Dr. Raymond C. Beeler, Indianapolis, Ind., Secy.

"In popular writing it seems to be necessary to link every great discovery, every new theory, every important principle, with the name of a single individual. But it is an almost universal rule that developments in physics actually come about in a very different way. A science, like a planet, grows in the main by a process of infinitesimal acretion. Each research is usually a modification of a preceding one; each new theory is built like a cathedral through the addition by many builders of many different elements." *The Electron.* Millikan.

DEPARTMENT OF TECHNIQUE

Department Editor: DAVID R. BOWEN, M.D., Pennsylvania Hospital, Philadelphia, Pa.

In this department will be published from time to time, as material is available, suggestions for improvement in technique.

A STRETCHER UNIT FOR THE ROENTGENOSCOPIC EXAMINATION OF BED PATIENTS

PLANNED ESPECIALLY FOR PULMONARY CASES

THE diagnosis of various chest conditions, particularly pleural and pericardial effusion, and the examination of cavities, especially abscess cavities, demand some position in addition to the supine or prone recumbent position. Most postpneumonic complications occur in patients too ill to assume the erect posture. For these the anteroposterior or posteroanterior projection with the patient lying on the unaffected side, will afford practically all the information to be secured by the erect posture. For instance, the homogeneous shadow of a half-filled abscess as seen with the patient supine or prone becomes so changed in this lateral posture as to give positive information, if, as often occurs, we find a distinct fluid level. Instances may be multiplied, but the present object is to exhibit the method rather than to discuss its uses.

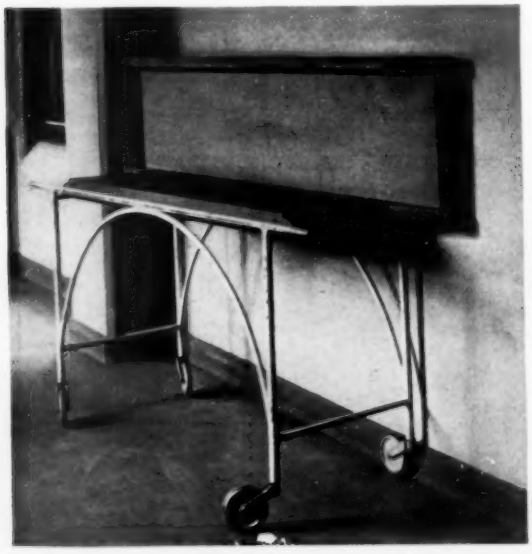

FIG. 1. A stretcher unit showing the carriage, stretcher and wooden platform.

The unit as illustrated consists of three parts:

(*a*) An oak frame, canvas-top stretcher, shown here as turned, edge upward, against the wall (Fig. 1).

(*b*) A light but firm wood platform, usually kept in the roentgenoscopic room, but here shown, as used, on the carriage.

(*c*) The carriage. This must be so constructed as to permit the use of parts (*a*) and (*b*), and with no wheels or bars to interfere with its use in front of a vertical or tilting roentgenoscope.

The carriage, with stretcher upon it, is taken to the bedside and the patient thus removed to the roentgenoscopic room. Without removal of the patient from the stretcher, the horizontal position study is made. The platform (*b*) is then placed on the carriage under the stretcher supporting the patient. This has the effect of placing the patient on a firm, unyielding table so that there is a complete support level with the stretcher top, quite rectifying the sag of the canvas.

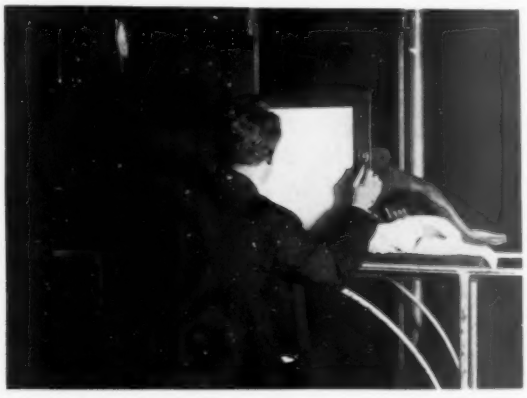

FIG. 2. Special stretcher in use before vertical roentgenoscope.

On this the lateral position study is made (Fig. 2). If the disease is wholly

unilateral, and if the patient can without serious difficulty lie on the unaffected side, the platform (*b*) may often be omitted; its sole use is to prevent the sag of any part of the patient's body below the upper level of the stretcher frame. A light wooden frame with iron handles at each corner may be substituted, if desired, for both the wooden platform and stretcher.

With most, perhaps all, types of the tilt-table roentgenoscope, it will be necessary to remove the screen ordinarily used and to use a larger screen which is not connected with, and does not move with the tube; this is for the obvious reason that the arm carrying the attached screen will come in contact with some part of the patient's body and thus prevent lowering of the screen to the level where the pathological condition can be visualized.

AN AID FOR THE SORTING, REPORTING AND FILING OF FILMS

THE handling of yesterday's films during the period of reporting and filing became, in our department, a matter of much inconvenience. In early years these were displayed upon a large illuminating box, but the work grew and the box did not; nor could room be spared to add further illuminating space. Therefore, the device here described came out of necessity. It has proven so satisfactory that neither our own personnel nor the hospital staff would care to return to the former method.

A box (Fig. 1) is provided, 18½ in. long, 14 in. deep, and 12 in. wide, mounted on legs and roller-bearing casters which raise its top to the total height of 34 in. Within are 100 pressboard guides 14¾ in. high and 18 in. long, which are numbered in one corner from 1 to 100. Tabbed cards might be preferred by some, but we have found these plain cut ones with Dennison sheet consecutive numbers pasted on, to be very satisfactory. For each guide card there is a manilla folder 14 × 17 in. in back and 14 × 16½ in. in front.

Suppose that the day's work begins with 36,624 and ends with 36,682; the films will be filed from 24 to 82 and, for the time, the 366 is disregarded. The next day's work will run from 36,683 to, say, 36,736. In the same way they will be placed from 83 to 100 and from 1 to 36. In the meantime, of course, folders 24 to 36 must have been filed.

Suppose in the first case—24 to 82—that 36,654 and 36,663 are re-examinations. Before the daily reporting begins the previous films will have been brought forward and put, with their respective folders, in the same number with yesterday's films of the same patient. When filed, the whole is kept with the new number. This has, it is true, the fault that there is some waste space in the older boxes, but this is more than compensated for by the saving in time when all the films of one patient are needed for comparison or study.

FIG. 1.

The illustration shows No. 55 card raised. In use this does not occur, but is so pictured to show that No. 55 is out;

and its folder is left partly out to indicate this.

Some saving in space could doubtless be made by using a combination guide card and folder, i.e., a single sheet of manilla folder could be attached, with a muslin hinge, to the guide card.

Being mounted on easy running casters, the box is readily available in the drying room for sorting, by the stereoscope for reporting and in the store room for filing. The device is not adaptable for plates and will be of less convenience in departments handling more than one hundred patients per day.

FURTHER REPORT ON A NEW TUBE HOLDER FOR ROENTGEN THERAPY

BY T. A. GROOVER, M.D., A. C. CHRISTIE, M.D., AND E. A. MERRITT, M.D.,

WASHINGTON, D. C.

OUR experience with the tube-holding device described by us in the July number of the Journal has been so satisfactory that certain improvements were made in order that minor defects might be corrected.

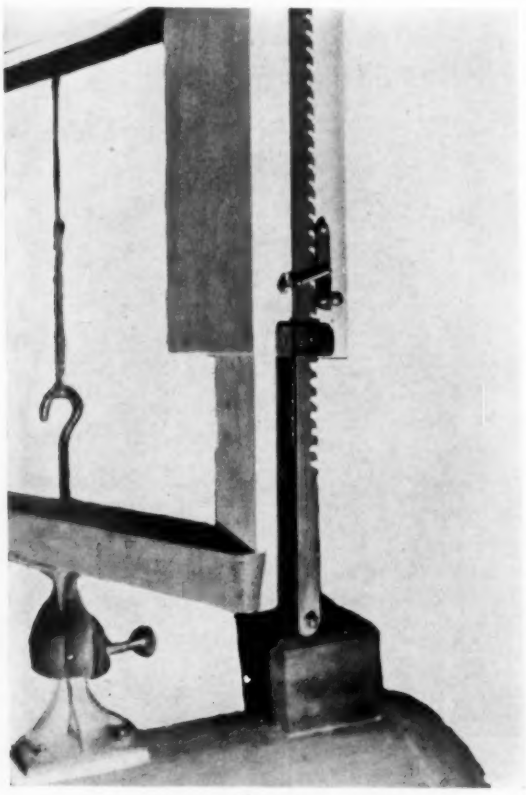

FIG. 1.

To overcome the danger from cable breakage, an automatic ratchet was fastened to one of the wooden tunnels; this ratchet engages by a spring mechanism as the tube is lowered or raised (Fig. 1). Its action is positive and it is sufficiently strong to support a weight many times as heavy as its normal load.

The second improvement was made in the cylinder itself. The present one is constructed of 16-gauge galvanized iron and covered with 4-lb. lead. The ends are concave and not lead covered. One end is closed permanently and the other supports a hinged door. The aperture in the side of the cylinder was increased to 5 in., and four metal lugs were soldered in the metal on the inside of the cylinder to hold filters in position. The door and lugs, with filter in place, are well shown in Figure 2.

FIG. 2.

To the closed end a flexible metal tube,

2 in. in diameter, connects with an electric blower which maintains proper temperature and successfully eliminates ionized air.

Finally, the dimensions of the cylinder were changed to permit of using higher voltages and to facilitate removal of the tube. The present cylinder is 39 in. in length and 15 in. in diameter (inside measurements).

Figure 3 shows the entire device.

Our indorsement of this device is based upon a year's usage and the following features may be accepted as especially meritorious:

1. Elimination of danger from electrical shock and static discharge.
2. Protection from roentgen rays to the patient and the operator.

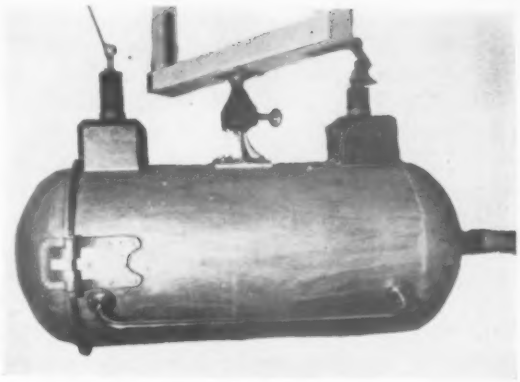

FIG. 3.

3. Ease of operation.
4. Impossibility of filters slipping.
5. Inexpensive construction.
6. Adaptability to space in room.

BOOK REVIEWS

TUMOURS INNOCENT AND MALIGNANT. Their Clinical Characters and Appropriate Treatment. By Sir John Bland-Sutton. Cloth. Price $7.50. Pages 783, with 383 engravings. 7th Ed. Paul B. Hoeber, Inc., New York, 1922.

This is the seventh edition of this excellent work on tumours. After an introduction dealing in a general way with the histology, age-distribution and the natural history of tumours, the author gives a concise description of each type of new growth. How completely this is done may be judged from the following partial list of subjects:

Group I. Tumour diseases of the connective tissues, including lipomas, tumours of bone, sarcomas of glandular organs, pigmented tumours, moles, neuromas, angiomas and lymphangiomas, uterine fibroids, etc.

Group II. Odontomes and dental cysts.

Group III. Epithelial tumours including papillomas, adenomas and carcinomas.

Group IV. Teratomas and dermoids.

Group V. Cysts.

Because of its compact form the book is an excellent one for reference with regard to the frequency, histology, location, and the surgical treatment of new growths. Only a few paragraphs are given to the subject of the treatment of malignant growths and of fibroids with the roentgen ray and radium.

CANCER OF THE BREAST AND ITS TREATMENT. By W. Sampson Handley, M.S., M. D. Lond., F.R.C.S. Eng. Hunterian Professor of Surgery and Pathology in the Royal College of Surgeons of England; Surgeon to the Middlesex Hospital and to its Cancer Charity, and Lecturer in its Medical School. Cloth. Price $7.50. Pages 404, with 82 illustrations. 2nd Ed. Paul B. Hoeber, Inc., New York, 1922.

This is the second edition of this excellent book, which the author describes in the preface to the first edition as "an attempt to place the operative treatment of breast cancer, hitherto, in some respects, still empirical, upon a more complete rational basis." Much space is given to the elaboration and proof of the author's original theory that the dissemination of breast cancer is by continuous growth along the lymphatic channels instead of by embolism. In the preface to the second edition the author states that the "permeation" theory has won wide-spread acceptance. Certain it is that he marshals arguments and pathological evidence in its support that are thoroughly convincing.

This edition contains new chapters on Radiological Treatment, Recurrence and its Operative Treatment, Paget's Disease of the Nipple, Lymphangioplasty and Injury as a Causative Factor in Carcinoma.

The following recapitulation gives a very good idea of the special points in Handley's "permeation theory":

(*a*) Carcinoma spreads centrifugally in all directions from the primary growth by permeation of the lymphatic plexuses which lie upon the deep fascia.

(*b*) Curative, and reparative processes inadequate for cure, are a normal part of the cancer process.

(*c*) Processes of inflammation and fibrous tissue formation are the principal agents in the defense of the body against carcinoma.

(*d*) Invasion of the serous cavities by cancer-cells is an event of critical importance in the process of dissemination.

(*e*) The embolic theory of dissemination is true only for exceptional cases.

This book should be carefully read by everyone who treats cancer. It is written by a surgeon, but by one who makes large use of both radium and the roentgen ray, and the two latter are given separate chapters for their consideration; both are frequently mentioned throughout that part of the book devoted to treatment.

THE ELECTRON. ITS ISOLATION AND MEASUREMENTS, AND THE DETERMINATION OF SOME OF ITS PROPERTIES. By Robert Andrews Millikan, Director of the Norman Bridge Laboratory of Physics, California Institute of Technology. Price $1.75. Contains 280 pages. University of Chicago Press, Chicago, 1923.

This is the Ninth Impression of this little volume which was first published in 1917. The general reader will find in it much that is interesting and instructive, but there are parts of it too technical in nature to be mastered by any but the trained physicist. Every roentgenologist should be thoroughly familiar, however, with the facts regarding the development of knowledge of the atom and electron here so interestingly set forth.

Not the least attraction of this book is its readable style. The author has the rare ability, possessed to so eminent a degree by Michael Faraday, of presenting scientific matters in a way to interest and instruct the general reader.

X-RAYS. By G. W. C. Kaye, O.B.E., M.A., D. Sc., F. Inst. P. Price $5.00. 320 pages and 124 illustrations. 4th Ed. Longmans, Green and Co., London, 1923.

The physics of roentgen rays and their relation to other forms of radiant energy are described in this book in a simple way easily comprehended by the roentgenologist. The reader finds instructive chapters on the measurement of intensity and quality of roentgen rays, on scattered, characteristic and corpuscular rays, and on ionization by the roentgen rays.

Chapters of more general interest are those on "*X*-rays and Industry," "Diffraction of *X*-rays" and "The Nature of *X*-rays."

There is much historical information throughout the book to increase its interest and value.

The volume contains many tables and formulas which are valuable for reference.

CHRONOLOGIA MEDICA. A HANDLIST OF PERSONS, PERIODS AND EVENTS IN THE HISTORY OF MEDICINE. By Sir D'Arcy Power, R.B.E., M.C. Oxon, F.R.C.S. Eng., and C. J. S. Thompson, K.B.E. Cloth. Price $3.50. 300 pages. Paul B. Hoeber, Inc., New York, 1923.

This little book does not purport to be a history of medicine but is actually a valuable reference handbook for names, dates and important events in medical history. In addition to a very complete biographical list of the noted names in medicine arranged chronologically, the book also contains a "Chronology of Drugs" and a "Chronology of Universities," together with an alphabetical index.

BOOKS RECEIVED

Books received are acknowledged in this department, and such acknowledgment must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

MEDICAL AXIOMS, APHORISMS AND CLINICAL MEMORANDA. By J. A. Lindsay, M.D., Price $2.25. 200 pp. New York: Paul B. Hoeber, Inc., 1923.

DIATHERMY AND ITS APPLICATION TO PNEUMONIA. By Harry Eaton Stewart, M.D. Price

$3.00. 226 pp. with 45 illustrations. New York: Paul B. Hoeber, Inc., 1923.

PHYSIOTHERAPY TECHNIC. By C. M. Sampson, M.D. Price $6.50. 448 pp. with 85 illustrations. St. Louis: C. V. Mosby Co., 1923.

RADIODONTIA. By Howard Riley Raper, D.D.S. Price $4.50. 202 pp. with 52 illustrations. New York: Dental Items of Interest Publishing Co., 1923.

INTERPRETATION OF DENTAL AND MAXILLARY ROENTGENOGRAMS. By Robert H. Ivy, M.D., D.D.S., and LeRoy M. Ennis, D.D.S. Price $4.00. 200 pp. with 403 illustrations. St. Louis: C. V. Mosby Co., 1923.

DENTAL AND ORAL RADIOGRAPHY. By James David McCoy, M.S., D.D.S. Third Edition. Price $3.25. 197 pp. with 116 illustrations. St. Louis: C. V. Mosby Co., 1923.

NOSOGRAPHY IN MODERN INTERNAL MEDICINE. By Knud Faber, M.D. Price $3.75. 235 pp. with 21 full page illustrations. New York: Paul B. Hoeber, Inc., 1923.

THE EFFECTS OF RADIUM UPON LIVING TISSUES. By Sidney Forsdike, M.D. Price $2.00. 80 pp. with 42 illustrations. New York: Paul B. Hoeber, Inc., 1923.

CHRONOLOGIA MEDICA. By Sir D'Arcy Power, K.B.E. and C. J. S. Thompson, M.B.E. Price $3.50. 300 pp. with 84 illustrations. New York: Paul B. Hoeber, Inc., 1923.

"I hope the age has many who will follow his (Sydenham's) example, and by the way of accurate practical observation, which he has so happily begun, enlarge the history of diseases, and improve the art of physic, and not, by speculative hypotheses, fill the world with useless though pleasing visions. I wonder that, after the pattern Dr. Sydenham has set them of a better way, men should return again to the romance way of physic. But I see it is easier and more natural for men to build castles in the air of their own than to survey well those that are to be found standing. Nicely to observe the history of diseases in all their changes and circumstances is a work of time, accurateness, attention and judgment, and wherein, if men through prepossession or obstinacy mistake, they may be convinced of their error by unerring nature and matter of fact, which leaves less room for the subtlety and dispute of words." Quotation from JOHN LOCKE in *Nosography* by FABER.

INTERNATIONAL ABSTRACTS OF ROENTGEN AND RADIUM LITERATURE

FOX, HERBERT, AND FARLEY, DAVIS L. Effect of *x*-ray upon histology of nodes in some cases of lymphadenopathy found by adenectomy during treatment. *J. Radiol.*, Aug., 1923, iv, 261–267.

SUMMARY (ABBREVIATED)

"There are recorded in this article the outlines of 7 cases of lymphadenopathy composed of the following diagnoses: One case of Hodgkin's disease in the cellular stage, one case diagnosed as Sternberg's pseudo-leucemic tuberculosis, one case with great similarity to this last disease but classed as sclerosing Hodgkin's disease, a case of aleucemic leukemia or systemic lymphomatosis, a case of leukemia cutis with sublymphemic blood, one of aleukemic leukemia or reticulum sarcoma. These diagnoses are made on the basis of a classification used by Dr. Farley and myself and now in press (*Am. J. M. Sc.*) . . .

"Strict comparison of the effect of *x*-ray cannot be made throughout the 7 cases because of the different durations of the individual instances, the character of treatment it was possible to administer and the length of such treatment. The 7 cases, however, fall into three groups about which some general observations are permissible. The lymph cell and its congeners are definitely reduced while the endothelial and fibrous tissue cells instead of being limited in production, seem definitely stimulated to multiplication. It is also very certainly demonstrated that there is no return to normal architecture in glands under the action of *x*-ray and radium. There is greater evidence of phagocytosis by large cells with vesicular nuclei in tissues that have been rayed than in those removed before treatment. . . .

"We do not wish to draw final conclusions upon the action of roentgen rays on lymphadenopathies from these seven observations. This is, however, a considerable amount of material, since reasons for repeated adenectomy are not often at hand. We would, however, draw concluding attention to certain features which have stood out prominently in our material. The first of these is the character of fibroses in lymphogranuloma and the disappearance of the large endothelioid cells in this process. The swollen reticulum and endothelioid cells of the leukemic hyperplasias as illustrated by Cases IV and V are not reduced, but made more visible, possibly by increase in number. The anatomy of the lymphocytes in these two cases was not appreciably altered by *x*-ray but their number was reduced. In the lesions suggesting sarcoma as in Cases VI and VII where endothelioid cells do not appear prominently in the original picture they do not become more visible with *x*-ray treatment. The principal cells of these tumor-like cases are greatly changed under *x*-ray both in arrangement and individual character. Fibrosis in the lymphogranulomatous varieties is much more voluminous than in the leukemic and neoplastic. Fibrosis does not seem to increase between the cells after treatment when it has not been present in this location before radiation. The statement made by other writers and repeated in an earlier paragraph that normal architecture does not return in an abnormal lymph node under the action of roentgen rays is fully confirmed by the descriptions and photographs."

WARREN, S. L., and WHIPFLE, G. H. Roentgen-ray intoxication. *J. Am. M. Ass.*, Nov., 1923, lxxxi, 1673.

CONCLUSIONS

"Evidence from animal experiments and scattered clinical observations is convincing that the human intestinal mucosa is peculiarly sensitive to the hard and short wave-length roentgen rays. A similar condition certainly obtains in the common laboratory mammals.

"It is probable that the intestinal epithelium is at least as sensitive as the skin epithelium, and it may be more sensitive when we consider its increased distance from the roentgen-ray target and the intervening body tissues.

"Erythema doses or larger doses given over the abdomen or the intestinal areas may cause injury to this sensitive intestinal epithelium. Particular care should be taken when 'cross fire' is used over areas that include intestinal coils, as the loops may be seriously injured.

"Local roentgen-ray injury to intestinal coils may not give rise to severe clinical intoxication, but may cause ulcers that are no less chronic and dangerous than are the familiar roentgen-ray skin 'burns.'

"It is very desirable that all cases in which erythema or larger doses are given over the abdomen be very carefully studied and reported so that our knowledge as to the danger limits may be comprehensive. Until such time, we must use the data obtained from controlled animal experiments. Such experiments indicate that the intestinal epithelium is quite sensitive to hard irradiation. These facts should receive careful consideration by the radiologist who contemplates radiotherapy of abdominal areas (for example, pelvic tumors)."

HOERNICKE, C. B. Roentgen treatment of tuberculosis of the bones and joints. *Muncben. med. Wcbnscbr.*, July 20, 1923, lxx, 943.

Iselin proposed maximal radiation for tuberculosis of the bones and joints. Later he used less than the erythema dose, for fear of ulceration. Generally one-third of the skin erythema dose is employed, that is a dose, which, after one week's application causes slight reddening of the radiated skin, and brown discoloration after four weeks' application. Where abscess or fistula has formed smaller doses must be given. Some fibrous forms will remain uninfluenced. They must be treated with up to 60 per cent of the cutaneous erythema dose, at the focus. Within six weeks the skin gets, at most, one skin erythema dose. After three treatments an intermission of three months should be made. The screens used are either aluminum, copper, or zinc, according to depth of focus and type of skin.

Orthopedic and general treatment should be carried on simultaneously, especially where other tuberculous foci exist in the body. Splints which are used on the lower extremities should be changed every six weeks, and the radiation made at that time.

Tuberculin sensibilization of the focus may be of good effect, because it causes hyperemia. Surgery cannot entirely be replaced by roentgen rays, as had been hoped.

The customary doses have no influence upon the healthy bone and cartilage, while tuberculous granulations are hypersensitive to roentgen rays. If granulations surround a bony part, they will sequester it. A cavity with sharp borders will remain, which is filled in very slowly by bony tissue.

BUCKY and KRETSCHME. Roentgen rays for the improvement of the general conditions of feeble children. *Klin.-therap. Wcbnscbr.*, Aug. 6, 1923, ii, 1498.

While treating children for bronchial and pulmonary tuberculosis, with roentgen ray, the author noticed that the general state of health of the children greatly improved, after the first radiations. Not only did fever, cough and night sweats decrease, but fatigue and lassitude, for which some children were brought to the author, also disappeared, and the children seemed brighter, developed a better appetite. In two or three weeks they would gain 2 to 4 kg. The results were the same during convalescence from influenza, or other infectious diseases, and for overexertion in school, neuropathies and under-nourishment.

For these treatments one-half cutaneous erythema doses were applied over the sternum. When the effect wore off, after four to six weeks, treatment was renewed.

In 50 children the results were very satisfactory. In children with secondary anemia the hemoglobin increased, after two to three days, and was marked after two weeks. The increase in erythrocytes, though it existed, was not so marked.

MUELLER, WALTHER. Influence of roentgen rays on the bones. *Muncben. med. Wcbnscbr.*, July 27, 1923, lxx, 980.

The conclusion is reached that bony tissue, once formed, will undergo practically no change, even upon intense radiation. Cartilage has been found rather sensitive to roentgen rays. It still is true that a growth-promoting roentgen-ray effect in normal tissue, and more especially in growing bony tissue, is theoretically possible. But practically it has, so far, not been demonstrated. Roentgen rays, beyond doubt, arrest the growth of a fracture callus, when given in large doses.

NAKAHARA, WARO. Studies in *x*-ray effects. *J. Exper. Med.*, Sept., 1923, xxxviii, 309–314.

The curative effect of roentgen rays on cancer cells depends on the reaction induced in surrounding normal tissue.

Cancer grafts will rarely grow when inoculated into tissues which have received an erythema dose of roentgen ray, while grafts from some tumors will grow actively in the unradiated parts on the same animal. Sixteen mice were roentgen-rayed through an opening in a lead plate 15 × 20 mm. The dose was as follows: 3 in. spark-gap, 10 ma., 6 in. distance, 2½ min. Seven days later they were inoculated with cancer grafts (Bashford adenocarcinoma No. 63) in the roentgen-rayed and in the protected regions. Six were killed, a pair at a time, forty-eight hours, four days, and seven days after cancer inoculation. The cancer grafts, with the surrounding tissue on both sides, were removed and fixed in Conroy's chloroform-alcohol-acetic fluid.

The other ten were killed in pairs, twenty-four hours, forty-eight hours, three days, five days, and seven days after cancer inoculation. The grafts were removed and fixed in formaldehyde.

Six controls were subjected to the same roentgen-ray treatment and inoculations, but not killed; in three weeks five out of six inoculations in the protected area resulted in vigorous tumors and only one tumor in six inoculations in the roentgen-rayed area.

SUMMARY

Cancer cells implanted in a skin area previously exposed to an erythema dose of

roentgen-ray show a series of degeneration changes comparable in every way to those described in cancer-cell degenerations following roentgen-ray treatment. This contrasts strongly with the survival and growth of grafts implanted in unexposed areas in the same animal. The result is the same whether the cells are exposed directly in situ or merely implanted in the previously exposed skin.

OCHSNER, A. J. Cancer from the surgical standpoint. *Radiol.*, Sept., 1923, i, 1.

After referring to the history of surgery of cancer the author refers to the use of the red-hot soldering iron as an operating instrument and then to the electric cautery and says that in all of these cases the patients have had after-treatment with roentgen ray, so that we cannot be certain about the part each of the two methods had in preventing recurrence.

He considers it best to place the entire radiologic treatment in the hands of an expert radiologist.

He feels certain that a number of lives have been saved by wide excision, preferably by means of the actual cautery, and that many of his patients are alive today who would have died had they been treated with radium and roentgen ray, either combined or singly.

He feels that all cases of malignant growth should be treated with roentgen ray before operating; that this kills the cancer cells which have progressed beyond the field of operation, produces immunizing substances, and prevents grafting of cancer cells with the knife as it passes through some lymph gland or space beyond the tumor proper.

He is not certain whether it is best to operate immediately after the patient has recovered from the depressing effect of deep roentgen-ray therapy or to wait several days or weeks. At present he operates within a week after the recovery.

In many cases he gave several courses of roentgen-ray treatment at intervals of from six to sixteen weeks following the operation. A number of these cases are alive after from five to sixteen years.

Since using a more powerful machine they usually give one prolonged treatment following the operation.

In some cases it has seemed that patients who received one prolonged intensive treatment before the operation and none afterward were more likely to remain free from recurrence than those who were treated before and after.

He refers to three blunders that were committed which resulted in the death of the patient: (1) Waiting to make certain of the diagnosis of cancer. By this time metastatic infection had occurred and the case was hopeless. (2) Scrapings or sections of the suspicious tissue were examined microscopically. At that time these specimens were removed with the knife or the curette. These patients died regularly from metastases. Not a single case in which the scrapings or the piece excised with the knife showed the presence of cancer has escaped death as a result of metastatic infection. (3) The tumor was removed with a knife. These patients had local recurrence and later metastases, but they all died.

Among his conclusions are: remove a malignant growth at the primary operation as widely as you would expect to remove it after the first recurrence; use the actual cautery whenever it can be used; always work in conjunction with a competent radiologist.

SIELMANN, HANS. Influence of roentgen rays on the sodium chloride metabolism and its relations to the therapy of "Roentgenkater." *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1923, xxxi, Kongressheft, 87.

Experimentally, it has been shown on dogs with vesicular fistula that the urine is increased and that potassium chlorid is eliminated to a higher degree after roentgen treatment. Parts of the skin and the liver were examined for their potassium chlorid content. It was found reduced up to 33 per cent. In the Institute Holzknecht 200 patients were treated with salt, and it seems that the bad effects of roentgen treatment were greatly reduced by it.

It must be mentioned, however, that the change in the salt metabolism is not the only cause for the malaise following radiation. It seems that the entire mineral metabolism is put out of balance, and that probably the albumin is also influenced. A firm in Vienna (Chemosanwerke) has prepared gelatin capsules with 1 gm. pulverized sodium chloride, adding a small amount of menthol-Valerian, and also glass vials with a 10 per cent. sodium chlorid solution called roentgenosan. These have been used with good effect in the above-named roentgen institute.

COTTE, G., and MICHON, L. Epithelioma of the uterine cervix of the type of perithelioma. *Bull. Soc. d'obst. et de gynéc.*, May, 1923, xii, 305.

There is presented a study of histological sections taken from a tumor of the neck of the uterus, the mass extending out of the neck into the vagina. At first view and under low magnification one saw in a uniform field stained with eosin rounded or elongated masses strongly colored with hematin and all centered on a vessel. The preparation recalled those tumors

elsewhere described under the name of perithelioma. The axis of the neoplastic nodule is formed by one or several vessels with capillary structure and sheathed in a sleeve of neoplastic round cells with a large nucleus. These nodules are scattered in a mass of necrobiotic tissue in the middle of which one can recognize no element. It is evidently an epithelioma, but the neoplastic cells are localized in the length of the vascular sheaths, whence the peritheliomatous aspect. Such tumors are rare, above all at the level of the neck of the uterus.

The authors found them described only in the book of James Ewing on "Neoplastic Diseases," who says that in certain atypical epitheliomas of the neck, with rapid growth, the cells arrange themselves around the vessels giving a peritheliomatous structure.

After removing a specimen for histological examination two tubes of 30 mg. each of bromide of radium were placed in the uterine neck from August 8 to August 10. The patient refused a second application of the radium on account of the pain induced by the first application, but the tumor disappeared clinically in less than eight months. This tumor was peculiarly sensitive to the action of radium. A dose of 25 mc. sufficing in place of the usual 50 mc.

PRITCHARD, J. S. Some interesting cases of calcareous degeneration found in the thorax. *Arch. Int. Med.*, Aug., 1923, xxxii, 259–282.

After an exhaustive historical summary of clinical observations and experimental work on this subject the author gives the following summary of the etiological factors in calcareous degeneration.

1. Any irritant to the tissues, either mechanical, chemical or infectious, the latter being a most important factor in the cases presented in this article.

2. Any condition which lowers the vitality of the organism.

3. Changes in the composition, velocity or volume of the blood.

4. Interference with the general or local nutrition.

5. The questionable effect of blood and tissue chemistry.

6. Poor assimilation or deficient metabolism of the involved tissues.

7. Constitutional conditions affecting the general metabolism.

8. Any disease of the osseous system which may cause the liberation of lime salts.

9. Alterations in the tissues which cause retention of chronic irritants, such as necrosis, suppurations, chronic inflammatory changes or traumatism.

10. Special selective power of certain tissues for lime salts.

11. The effect of sunlight on the body tissues and metabolism. The production of rickets in mice through deficient supply of actinic rays suggests the presence of a definite influence of sunlight on the process of calcification.

12. Vasomotor disturbances.

13. Possible influences of endocrine derangements.

14. Variations in the carbon dioxide blood content.

15. Hemorrhage into the tissues.

16. Factors influencing osmosis.

17. After all theories have been propounded, there still remain a goodly number of cases of calcareous degeneration unexplained from the etiologic standpoint.

Calcareous degenerations may occur in almost any tissue of the body, the peritoneum being perhaps the least frequently affected.

There was made at Battle Creek Sanitarium Clinic a routine procedure in 7,000 cases as follows: at the time of the physical examination of the chest a careful history was taken; the laboratory finding included a Wassermann test. In each case stereoscopic chest plates were secured which were interpreted by the writer in conjunction with the clinical study. The final opinion was based on a summary of the whole investigation. Nevertheless it is with considerable hesitancy that any opinion is offered. A few points present themselves which may be of importance: 1. The number of cases with frank lesions in the upper portions of the lungs, active or inactive, which showed no definite sign of calcification in the thoracic cage is remarkable. 2. Extensive calcification of the ribs or cartilages occurs frequently without any pulmonary disease. 3. The long, thin, flat, narrow thorax may be more prone to calcification of the upper anterior part but in the author's series he has found a considerable number of calcified deposits in all forms and types of the adult thorax.

Calcification of the pleura is not uncommon. Empyema is the most common cause, when the deposits take the form of plaques or platelets. The clinical history suggests that most of the pleural calcifications are probably not due to the action of the tubercle bacillus.

The diagnosis of calcium deposit was seldom made prior to autopsy before the advent of the roentgen ray. The dense, hard, concrete, clean-cut shadow in the roentgenogram is characteristic.

Concretions in the lungs produce no symptoms unless they cause erosion of the bronchi or lung tissue, in which case they act as a foreign body.

Fifteen case reports are given, illustrated by roentgenograms.

PANCOAST, HENRY K. Roentgenologic studies of pneumoconiosis and other fibrosing conditions of the lung. *Ann. Clin. Med.*, 1923, ii, 8–23.

There are three definite sets of shadows in the normal lungs due to the hilum, to the trunk shadows and to the finer linear markings. The conglomerate shadow of the hilum is distinctly visible on each side of the denser shadow of the heart and great vessels and is cast by the bronchial walls, vessels, connective tissue, lymph-nodes and all non-air containing structures at the root of the lung. The trunk shadows fade into the finer disappearing linear markings.

These shadows may be accentuated, or areas of structureless lung be made visible by active or passive congestion or fibrosis. The appearance is frequently not characteristic of the disease, when history and other clinical data aid materially in forming a correct interpretation.

The roentgen study must be regarded as a single method of examination in addition to the clinical procedure and a correlation of the combined data is essential in reaching a correct diagnosis. Roentgenoscopic observation is important in study of fibrosis of the lung. Fibrosis limits the movements of the diaphragm because of the resulting lessened elasticity of the lung and through the additional involvement of the pleura and even the diaphragm.

The two most frequent causes of fibrosis of the lung are tuberculosis and pneumoconiosis. In each the active agent is airborne and gains access to the pulmonary lymphatic system from the air passages beyond the range of the ciliated epithelium. It is usually possible to determine the presence of pneumoconiosis even when both conditions are present, and where doubt exists a proper correlation of the roentgen and clinical data will practically settle the question. There may be clinical points of resemblance between the two conditions and positive sputum or repeated negative findings will be the deciding clinical factor. The two conditions frequently exist in the same individual. Pneumoconiosis apparently protects from tuberculosis, though more complete statistics may dispel this impression.

Inspiration of dust is not itself harmful. The quantity is not so important as the quality, the important injurious constituent being silica. The dust in potteries does not produce pneumoconiosis in the absence of silica. Pneumoconiosis is found among farmers in sandy soils and among those who live where sand storms are prevalent. Miners who work in the harder rocks with large silica content show much more marked changes in the lung than those of the coal mines.

A knowledge of the histology of the pulmonary lymphatic system and of the lymphatic drainage of the lung simplifies the understanding of the roentgen appearances of the lung.

There are three stages of progress from the roentgen standpoint: 1. Peribronchial and root thickening; 2. localized parenchymal fibrosis; and 3. diffuse fibrosis.

The increased extent and density of the hilum shadows and the increased prominence and thickness of the radiating trunk shadows found in the first stage is by no means characteristic of the condition. The same appearance may result from any respiratory infection or irritation, congestion, or infiltrating metastatic carcinoma. Any dust not containing silica may cause it, but such dusts do not produce the subsequent stages of pneumoconiosis. Silica probably gains entrance to the lymphatic system mostly beyond the ciliated epithelium. Some of it is deposited in the adjacent lymphoid deposits, but much is carried onward by the lymph vessels and deposited in the lymph glands at the root of the lung where it acts as an irritant and produces fibrosis.

The characteristic diffuse fibrosis of the second stage is always very striking and is at once recognized as pneumoconiosis. The distribution is characteristic as well as the appearance. There is nothing with which it can be confused except possibly the appearance in some cases of miliary tuberculosis.

The third stage is that of diffuse fibrosis. The appearance is more or less symmetrical and resembles the end result of no other condition but that of symmetrical diffuse tuberculosis.

The transition from the second to the third stage seems to take place most frequently as an apparent conglomeration of the mottling into larger areas resembling consolidations, usually with the densest areas in the subapical regions.

The lymph drainage of the lower lobes differs from the other portions passing to and through the ligamentum pulmonale and not to the hilum. The fibrosis may displace the heart and great vessels, restrict costal expansion and limit diaphragmatic movement. Emphysema is a constant result and bronchiectasis frequently occurs.

CLOPTON, MALVERN B. Eventration of the diaphragm. *Ann. Surg.*, 1923, lxviii, 154–163.

This article presents two cases of eventration of the diaphragm that offered interesting

problems in diagnosis, leading in one case to an unnecessary operation.

There is a high-lying diaphragm on the left side, with the stomach, spleen, and large bowel occupying the space usually filled by the lung. The heart is in the right chest. The stomach is large. The large bowel is also dilated and enlarged; the liver vertical and right sided. The chest wall shows a slight bulging of the lower half of the left side. This condition was designated by Cruveilhier as eventration of the diaphragm. It occurs nearly always on the left side. The chief confusion in diagnosis will be with diaphragmatic hernia. In roentgenoscopic examination, the diaphragm moves with respiration. In diaphragmatic hernia, a "paradoxical expiratory displacement" has been noted—with forced inspiration the herniated diaphragm ascends, and with expiration it descends.

Eventration has been operated on because of a diagnosis mistaking it for pyopneumothorax, as in our first case, and as in a case reported by McNab.

ELIOT, ELLSWORTH, JR. Certain features of renal calculus. *Ann. Surg.*, 1923, lxviii, 231–238.

Urine collected by ureteral catheterization from either kidney does not always show the same composition and may vary to such an extent as to actually differ in reaction.

The subjective symptoms, while of relatively small diagnostic value, are of importance in leading to roentgen examination and for that reason deserve study and consideration. Pain, unquestionably the most constant symptom, is subject to frequent variation. In place of the typical lumbar pain radiating downward and forward along the course of the ilio-inguinal nerve, this symptom may be more or less localized and even referred anteriorly to a point above or below the level of the umbilicus. This is of importance in the differential diagnosis of renal calculus from inflammatory conditions of the gall-bladder, duodenum and pancreas, and strongly emphasizes the need of roentgen examination.

Renal calculus may be without symptoms. The writer believes that this is much less frequent than in gall-stones.

The roentgen ray has proved of the greatest value in determining the number of calculi and their approximate positions. This information ordinarily directs the point of attack, and defines the limit of operation so that unnecessary exploration is avoided.

The need for careful investigation of the chemistry of the urine of the affected kidney, both before and after operation, and comparison of this to the normal kidney is great. Future progress in the treatment of this condition surely lies in the development of the knowledge of those changes of tissue metabolism which predispose to their formation and to the discovery and adoption of suitable measures to regulate and maintain normal metabolic changes in the tissue cell.

WILLIAMS, JOHN G. X-ray treatment of lesions of the thyroid gland. *Long Island M. J.*, 1923, xvii, 353–359.

Plummer has shown that the intravenous administration of 10 mgm. of thyroxin to a patient with myxedema elevates the basal metabolic rate 28 points. The maximum elevation is reached from five to ten days and does not return to the previous rate until thirty or forty days later. Clinically, he determined that 6 mgm. daily is the average requirement of an ordinary case.

Cannon and Smith have shown that stimulation of the cervical sympathetic causes increased secretion of the thyroid. He classes goiter as simple, cystic, colloidal, adenoma, exophthalmic, and malignant. Of these, the adenomata with hyperthyroid symptoms, the exophthalmics, and the malignant cases are suitable for roentgen therapy. Usually, a basal metabolic rate in excess of plus 15 is found in hyperthyroidism.

Toxic adenoma responds readily to the roentgen ray but surgery is quicker and the mortality in these cases is low. The technique has been to treat the thyroid and thymus areas on each side separately with four mm. of aluminum as a filter, a nine-inch spark-gap, at a distance of nine in., for six minutes to each area. Latterly, where the tonsils showed marked hypertrophy, he has included them in the area to be treated, extending the distance to twelve in. and time to nine and one half minutes. The second treatment is given three weeks later, and a third treatment four weeks after the second, the interval between treatments being extended one week longer than each preceding interval. Usually, at the third visit, seven weeks after the first treatment, there is noted a slowing of the pulse rate and an amelioration of the nervous symptoms. After this, the patient begins to regain some of the previous loss in weight. The eye symptoms and the goiter are the last to show improvement, and frequently do not wholly disappear.

Among his conclusions, he says that patients treated surgically do better and the risk of operation is less if they had previously had their thymus glands irradiated.

GRASHEY, R. Rare roentgen findings. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1923, xxxi, Kongressheft, 59.

At the Congress several rare pictures were shown; first, pericardial calcification as large as a twenty-five cent piece in the apex of the heart of a woman fifty-six years old, with hepatic enlargement and swelling of the lower extremities.

Second, calcification of the pleura in a man, fifty-three years old, who had suffered thirty-three years previously of pneumonia. He had had emphysema and bronchitis. A dense, arched, notched shadow was seen which passed below the ribs when the patient turned. A roentgenogram of the post mortem section showed calcification of the pleura. In a woman, forty-one years old, there was a long, dense, notched shadow which ascended vertically, and crossed the shadow of the vessel; parallel with it was a brooch-shaped shadow; the diaphragm was adherent. A man fifty-five years old, showed a shadow on the left side in front and above, starting at the apex. It was dense and sickle-shaped, bent like the ribs, but not quite as much. Granular structure was seen at the lower portion. He had been stabbed twenty-five years previously in the upper part of the thorax. Probably this was the old canal where the dagger had penetrated.

Third, extensive ossification of the tendon of Achilles; the arteries were hardened. Man seventy-four years old.

Fourth, egg-shaped calcification in the right kidney containing carcinoma.

Fifth, forked ribs. One was the left third rib, and in another case the first rib on both sides.

Sixth, a case of Koehler's metatarsal disease in a girl sixteen years old who had been treated for spina ventosa of the first and fourth fingers. When a child, she had suffered glandular swelling and inflammation of the eyes. For two years she had had pain in the head of the second tarsal. No traumatism could be remembered.

Seventh, myeloma in a man seventy years old, who had complained of pain for six months in the entire thorax. He was emaciated and pale. Albumin bodies (Bence-Jones) were found in the urine; in the blood 18,000 white blood corpuscles, of which 80 per cent. were plasma cells. Later they increased to 80,000. The roentgenogram showed spotted light areas in the ribs, with a healed spontaneous fracture.

STRAUSS, O. The influence of roentgen rays on endocellular and metabolistic processes. *Fortschr. a.b. Geb. d. Röntgenstrahlen*, 1923, xxxi, Kongressheft, 80.

It has been shown, experimentally, that roentgen rays cause: First, a decrease in the cholesterin content of the blood; second, increase of osmotic pressure in the blood; third, the decrease of surface tension; fourth, the increase of hydrogen ion concentration; fifth, changes in the mineral metabolism.

This causes an effect upon the lipoid mixture which explains part of the roentgen-ray effect on the cell.

GROEDEL, FRANZ. Heart motion in the roentgen kinematogram. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1923, xxxi, Kongressheft, 42.

Roentgen moving pictures serve the purpose of showing the motion of the internal organs and making deductions from them. Two to four pictures a second will be sufficient, but for some of the more rapid proceedings, especially those which occur in the heart, a correct speed at ten to sixteen pictures a second must be made.

The pictures which Groedel showed at the meeting of the Congress demonstrated three different stages of the heart action: First, the pumping, where the right and left borders of the heart, for a short time at least, showed a contrasting position which alternated. Second, the pendulum movement, which, for a longer period, will show the left border of the shadow in a contrasting position, while the right is dilated and vice versa. Third, peristaltic action was seen on both borders, appearing as a progressive contraction of the border of the shadow from above downward.

For scientific purposes the pictures must be supplemented by electrocardiographic curves. On these curves the single phases must be marked. The author combined the two in a kinematogram on a "trick film."

ALTMANN, V., ROCHLIN, D., and GLEICHGEWICHT, E. The effect of roentgen rays upon growth acceleration and retardation. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, July 5, 1923, xxxi, 51.

To study provocative doses of roentgen-rays the authors at first used plants. These investigations, however, did not give any definite basis for the influence upon pathological conditions. It was found that the irritation produced a temporary acceleration of development and an influence upon the vitality of the tissues, which seemed even to have a detrimental effect upon them. The question is asked which pathological processes would be amenable to this therapy. The authors say, hardly tuberculosis, for it is not proven that this irritation will have a lasting beneficial influence upon the defensive tissues. The dosage cannot be definitely determined. The effect will

be similar in all other processes where a provocation of growth of an existing or forming normal or pathological tissue is expected.

The results of these experiments are somewhat comforting in the line of carcinoma therapy. The danger from lower grade rays seems at least exaggerated.

WIMBERGER, HANS. Roentgen symptomatology of the infantile mediastinum. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, July, 1923, xxxi, 33.

It seems that air accumulates more frequently in the infantile mediastinum than in that of the adult. It may enter through the throat or the lungs. In the first instance, expiration is impaired, and in laryngeal diphtheria, with or without tracheotomy, and in pertussis it has often been observed. If starting from the lung, interstitial emphysema is the cause, a disease which is characteristic of childhood. It will occur in laryngeal croup, pertussis, pneumonia, tuberculosis and will either pass between the lobular sections beyond the pleura, or along the peribronchial tissues, across the base of the lung to the mediastinum, where high grade distention may ensue. It may pass into the pericardium and upward in the subcutaneous tissue of the neck.

Dupuytren, as early as 1837, diagnosed mediastinal emphysema in an infant ten months old. Clinically, a small vesicular rubbing sound, which is synchronous with the heart action, will be heard sometimes over the entire extent of the sternum, extending toward the right to the parasternal line, and to the left as far as the mammillary line. Cardiac dulness will disappear partly or entirely, and instead, a sonorous percussion sound will be audible. In some cases cardiac dulness is unimpaired. The displacement of the lung and heart may cause involvement of the heart and circulation.

No roentgenologic diagnostic signs of this disease in the child have been described excepting by Assmann, who finds light bands along the borders of the central shadow, or light spots within the shadows of the soft parts. Bergmann describes the findings in an adult where a light triangle was seen over the diaphragm, it was paravertebral. He considered the case one of mediastinal pneumothorax. One might also think of paramediastinal genuine pneumothorax.

Child, two months old, badly nourished, suffering from kerato-malacia. Purulent discharge from the eyes, which disappeared upon giving cod-liver oil. Five weeks later dyspnea with short inspiration and labored expiration, no cough, auscultation of the lungs negative. Another three weeks later bulging of the upper sternal region. On the left side in the back above great dulness, without distinct bronchial respiration. Patient died after having been ill seven weeks.

The roentgenogram showed very large distended thorax, ribs in position of inspiration, which is almost entirely diaphragmatic. The very light lateral part of the right pulmonary area, in its center, merges into a fine striated shadow, with a medial paravertebral narrow, light zone. The heart is displaced into the left pulmonary area so that only an opaque phrenicocostal angle and an abnormally light upper third of the lung is visible. The retrosternal space is very large and light, the heart displaced backward and downward. Roentgenological diagnosis lay between pneumothorax and mediastinal emphysema. The latter was taken as more probable on account of the abnormal air contents in the spotty diffuse mediastinal channel. The roentgenogram changed when the patient died so that the heart was then not as far displaced toward the left. Post mortem revealed interstitial emphysema of the right lung, with many vesicles on the mediastinal side. Confluent lobular pneumonic foci were seen in both lower lobes and at the base of both upper lobes.

Another case of pneumomediastinum in a child seventeen months old is described.

LEUSDEN, P. Roentgen ulcers, and their surgical treatment. *Med. Klin.*, Sept. 2, 1923, xix, 1181.

Not all patients who have roentgen ulcers have been rayed by physicians inexperienced, or not sufficiently familiar with roentgen-ray methods. Quite a number have been in the hands of successful roentgenologists. Many members of the profession must work with old apparatus, not altogether up to date. But even those who have all the refinements of the method do not escape suits for malpractice in this field. After all not all problems involved in roentgen rays have been definitely solved, and the difference in toleration in each individual, the appropriate focal distance, dose, and screening cannot always be estimated with mathematical accuracy. Treatment tolerated by scores of patients will suddenly, in another individual, produce harm. The difference in individual tolerance is estimated at 15 to 20 per cent. Discrimination has greatly improved, and not all cases are treated by the roentgen ray which was the case, for a period, not long past. Operation is deemed necessary, in more instances, even by enthusiastic roentgenologists, who, not long ago, denied the necessity of surgery.

Generally the cases coming to the author are subacute or chronic, and all suffered intense pain. In one case angioneurosis developed. The pain, the author thinks, is caused by the baring of nerve ends in the wound, which are not covered by granulation. The toxic necrotic surrounding tissue keeps up an irritation. To allay this pain "Zykloformvaseline" (10 per cent) has been most effective.

The ulcer is most painful, has well defined borders, and a necrotic yellow base, with red and blue groups of vessels.

The best treatment is to cut out the ulcer like a malignant neoformation, reaching into healthy tissue. Bridge flaps or pedunculated flaps are desirable, containing a larger artery for nutrition. It is not advisable to take flaps the ends of which extend across the median line. The flaps must be one and one-half times as large as the defect. Epithelial pulp is used in the after-treatment of the flap defect. Where thickening at a site which has been roentgen-rayed, arouses the suspicion that a roentgen ulcer is forming, it is well to make a prophylactic excision.

TESCHENDORF, W. Representation of the gall-bladder in the roentgen picture by means of distention of the duodenum and jejunum. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1923, xxxi, Kongressheft, 54.

The distention of the transverse colon from the rectum had been suggested for demonstrating the gall-bladder on the screen. Henszelmann made the projection from behind and above downward into the front along the slant of the lower surface of the liver. The patient was rotated to the second diagonal diameter. This method was not always successful. Even the pneumoperitoneum did not always assist. The author introduced air into the duodenum by means of the duodenal tube. On an empty stomach the duodenal tube is introduced through the nose. If the tube does not pass the pylorus easily a small quantity of milk can be given because the head of the tube willl penetrate more easily when the casein is passing the barrier. When the duodenal fluid is flowing freely the tube is pushed down farther, for without this much air is retained in the stomach. In order to close the pylorus, thick barium meal is given, then sufficient air is introduced to cause a sensation of pressure. Air will reach the first jejunal loop from the duodenum readily. Much air can be introduced in this manner. If it should be retained in the stomach, the patient is directed to dispel it by eructation. The plate is made in the position described by Henszelmann, but not in the oblique position.

The author admits that practice is necessary for perfection in this method.

KUEPFERLE. Anatomical analysis of the roentgen picture in pulmonary phthisis. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1923, xxxi, Kongressheft, 14.

The author studied the roentgen pictures of patients with pulmonary phthisis, and sections made, post mortem, after injections of formalin. Comparing these, he had better results than with the post mortem roentgenograms. In roentgenograms, lobular exudative formation of foci resemble bronchopneumonia foci. Blurred, spotty shadows are produced. When large areas of the lung are involved, these shadows will become confluent. The anatomical focal reaction will produce secondary changes of induration and scar formation on one hand, and caseation and degeneration on the other. They are all well demonstrated in the roentgenogram. The two latter conditions will produce dense shadows. The resulting shrinkage and distortion between the indurated foci will show as light spots between the dense shadows. Fibrinous changes will often show up as irregular branching, striated shadow formations. The recognition of cavities in the roentgenogram is dependent somewhat upon the changes of their walls. Often focal changes outside of the cavity will project shadows into them. Indurations, in their walls or surroundings, will often show up in the shape of rings or bands grouped about the lumen. Cavities generally form in the back and upper sections of the lung. They extend forward and downward. Their recognition is rather difficult. Bronchial involvement will show an arrangement of foci in groups in the various pulmonary areas on the roentgenogram. If the foci are disseminated the pathological process may be considered hematogenous.

PORDES, F. On the nature and effect of roentgen rays, especially on the disappearance of anuria on radiation of the kidney. Zentral-Roentgeninstitut, Allgemaines Krankenhaus, Vienna (Prof. Holzknecht.) *Wien. klin. Wchnschr.*, Sept. 13, 1923, xxxvi, 656.

A two hours' debate ensued at the Roentgen Congress, when Holzknecht and Pordes expressed the opinion that the action of roentgen rays, in anuria, was not stimulation, but a relief of pressure in the infiltrated renal tissue. They argued that decapsulation of the kidney in anuria would reestablish its function. Anuria is caused by a condition of over-pressure, produced by inflammatory products, especially by leucocyte infiltration. Leucocytes are very

sensitive to roentgen rays, and are quickly destroyed by them. Radiation will relieve tension from infiltration, and will reestablish the renal function. This explanation would serve even if one would consider anuria a consequence of angiospasm, as does Volhard. The spasm would be eased.

This theory contradicts the Arndt-Schulz theory, according to which it is postulated that all agents stimulate all cells, when given in small doses, that they will paralyze in medium doses, and kill in large doses. This theory was very generally applied in its simplicity to roentgen action during the last few years.

RITTER, HANS, AND MOJE, OTTO. Experimental examinations on the effect of roentgen rays on tubercle bacilli and tuberculous tissue. *Strahlentherapie*, 1923, xv, 283.

It is well known that a number of tuberculous processes are reduced by the roentgen ray in a manner that would almost amount to a cure, for instance in tuberculous lymphoma of the neck. The glands will atrophy so far that for the rest of the life of the patient one may not be able to feel them. The nature of the effect, however, is not known so far. The effect is not a direct destruction of the tubercle bacillus. The process must be an indirect one. Backmeister says that the proliferating tissue is converted into scar tissue in the sense of nature's healing. The granular tuberculous tissue is destroyed. Rollier is of the opinion that the rays act as bacterioides, oxidizing, reducing, sclerosing, and modifying.

The authors tried a number of experiments on guinea-pigs which had been infected with tuberculosis. They were treated with roentgen ray in different doses, and at different times of the infection. At certain intervals the glands were cut out and examined for tubercle bacilli. The material of the excised glands was inoculated into healthy guinea-pigs in order to study the virulence of the bacilli. Radiation of the inoculated portion immediately after inoculation did not cause any change in the course of the tuberculous process with varying doses. This would show that the effect is not direct upon tubercle bacilli. Neither small nor large doses can effect the local resistive power of the body in the surrounding tissue.

Three animals were radiated with full doses of unfiltrated ray. The tubercle bacilli were neither killed, nor was their virulence diminished. The only feature which was of note was the extensive connective tissue proliferation, and the scar tissue formation.

A 10 X radiation with rays filtered through a 2-mm. aluminum screen was applied to tuberculous glands directly. One month later the glands were found caseous, containing abundant tubercle bacilli and pus. Evidently, the bacilli were not killed, and their virulence not diminished.

The authors arrive at the conclusion that roentgen rays alone cannot heal tuberculosis. Even if tuberculous lymphoma is caused to shrink, the patient must be regarded as a tubercle bacillus carrier. Disson has correctly intimated that one could not always decide whether a new infection had occurred, or whether the process of shrinkage had been reduced. The tubercle bacilli are enclosed in firm scar tissue, and must remain there so they may do no damage.

SCHWARZ, EGBERT. On injuries sustained during roentgen treatment of myomata and hemorrhagic metropathies. *Strahlentherapie*, 1923, xv, part 3, 398.

Roentgen treatment has been resorted to more and more during the last decades in benign diseases of the female genitals, especially in myoma. The technique of treatment is not as definitely agreed upon as is the indication. The various methods which had been employed since 1914 are that of Albers-Schönberg, which gave small doses in a series of radiations; the Freiburg technique which employed large doses in series; some authors then used medium, and others excessive doses in series. Recently, Freiburg has adopted a new technique, radiating once, 50 to 70 X surface dose equals 20 to 30 X deep dose. It is characterized by the application of the full castration dose in one session. Myoma and metropathies treated with this new technique have yielded 90.5 per cent cures, 0.15 per cent recurrences, 4.9 per cent improvement, and negative results in only 2.7 per cent of cases. When considered separately, myoma 90.5 per cent were cured, and metropathies 99.4 per cent. The complications consist mainly in slight erythema, while bladder and intestines are not irritated. Another group of reports gives nausea, vomiting, diarrhea, and roentgen malaise.

The author's experiences with carcinoma radiation have shown that the intestine will tolerate relatively high doses of 100 to 120 per cent. The Wintz numbers of 130 to 135 per cent are evidently the highest deep doses possible, but there are certain individuals who do not tolerate them, and who will develop hyperemia with comparatively low radiant energy.

The heavy filter in roentgen therapy has been very beneficial, although some sequellae have been disagreeable.

In using the Freiburg recent method, the author has found, in his material of women between forty-one and fifty-nine, excepting three, who were younger, that hemorrhage became more profuse in 11 instances, but 25 women definitely became amenorrheic, and remained so. No recurrence was seen in from one-half to two years. Only one woman was not rendered amenorrheic.

Even during the time of radiation, but more frequently later, vomiting was seen in 12 cases; furthermore, dizziness, headache, and diarrhea in 10 women, that is, 38.4 per cent. The complications were considerable in the beginning. These disagreeable effects lasted up to two months, generally ten days to two weeks. Diarrhea, in some instances, was almost uncontrollable, and the patients became much weakened by it. Intestinal tenesmus was excessive. Much slime and blood in some instances. But soon the patients began to experience the beneficial effects. The symptoms of artificial amenorrhea were not very marked, excepting in 2 cases.

AMELUNG, WALTHER. Can arthritis urica be diagnosed definitely by *x*-ray? *Fortschr. a. d. Geb. d. Rontgenstrahlen*, July, 1923, xxxi, 44.

Anatomically, as well as clinically and roentgenologically, arthritis deformans and polyarthritis chronica show definite differences. The former is characterized in the roentgenogram by marked proliferation of the bone and cartilage, with numerous articular bodies. Generally, there is no ankylosis, and atrophy of the skeleton is slight. In chronic polyarthritis there is a thickening of the capsule and the peri-articular soft parts, followed by an early porotic bony atrophy with marked tendency to ankylosis. Proliferation is not marked. However, deforming processes may set in in the latter stages of chronic polyarthritis. It is then that diagnosis becomes difficult. Aside from these symptoms, there are definite disturbances in the joint in gout which is characterized by accumulation of uric acid in the tissues and in the blood. Koehler, Jacobsohn, Drinberg, Brugsch and Wollenberg have shown that by the roentgen ray you can show certain changes which will allow of the diagnosis of uric arthritic. The change consists in oval or round transparent spots, with a border which is sometimes well-marked. They range from a few millimeters to a centimeter, and may occur singly or multiply in the epiphyses, and in the diaphyses. At first, only pits as large as the head of a pin will be observed at the ends of the joints, and the borders of the bone. These may change to bony defects, either round or crescent, or may appear punched-out. These are all typical signs for gout, and useful in early diagnosis. Krebs, however, is of the opinion that the same signs are seen in all chronic articular conditions. When, however, compared with the clinical signs, the diagnosis may be arrived at.

The author, in a series of 7 cases, demonstrates, however, that similar roentgenograms will be seen in chronic polyarthritis, arthritis urica, and arthritis deformans.

LEWIS, THOMAS. Movements of the heart axis with respiration. *Heart*, 1923, x, 264–265.

SUMMARY AND CONCLUSIONS

1. In a patient in whom a rifle bullet had become fixed in the ventricle, observations have been undertaken upon the movements of this bullet during the heart beat and during respiration.

2. The bullet showed a pendulum-like swing with the heart beat, its base (the lower end) moving conspicuously towards the heart's apex in systole and receding from it in diastole.

3. During expiration the bullet moved almost vertically upward; at the same time it altered its obliquity to the vertical, the movement being anti-clockwise. This change in the bullet's obliquity has been measured and the change of angle compared with that occurring in the electrical axis of the heart. The two changes were found to be identical in the erect position of the patient, but showed a conspicuous divergence while the patient sat.

4. It is thought to be improbable that movement of the electrical axis of the electrocardiogram resulting from respiration necessarily gauges accurately the movement of the heart's anatomical axis.

CAMP, JOHN D. The normal and pathologic anatomy of the sella turcica as revealed at necropsy. *Radiol.*, 1923, i, 65–73.

The dimensions of the sella turcica in normal specimens were measured in the anteroposterior, vertical and transverse directions. The anteroposterior measurements were taken from the most dorsal point of the tuberculum sellae in the sagittal plane. This represents the true anteroposterior dimension of the outlet of the pituitary fossa. The vertical or depth measurement was taken along a line dropped from the anteroposterior line to the deepest point on the floor of the sella. The width represents the distance between the lateral boundaries of the fossa.

Gordon and Bell, in a roentgenographic study of the sella in normal children, classified the

various shapes into three types: the circular, oval, and flat. The circular type was found in 70 of the cases studied by them, the oval in 25 and the flat in 10. These authors also conclude that there is no relation between the size of the head and the size of the sella, and that the shape of the sella has no significance except in the flat group, which is always found in small heads.

Applying the classification of Gordon and Bell to the series reported here, the oval type was found in 66 per cent, the round in 21 per cent, and the flat in 13 per cent of the specimens measured. The greatest anteroposterior dimension of the pituitary fossa was measured from the outlines in the sagittal plane along a line from the anterior wall to the farthest point on the posterior wall in the horizontal plane. The average distance of this dimension was 1.14 cm., the maximal distance 1.5 cm., and the minimal 0.8 cm. The average distance for this measurement will be somewhat more than that of the anteroposterior distance of the outlet of the fossa, due to the anterior curving of the dorsum sellae in the majority of specimens.

BAUMAN, GEORGE I. The relation of lesions of the transverse processes to pain in the back and legs. *J. Bone & Joint Surg.*, 1923, v, 579–589.

Routine roentgen examinations and dissections of the lower spine reveal wide variations in the length, shape and direction of the transverse processes. The nerve cords and parts of the lumbo-sacral plexus and some of their branches are in close proximity to and directly in front of the transverse processes of the lower four lumbar vertebrae. Any slight change in position of any of these processes due to fracture or rotation of the vertebral body can result in direct pressure on the plexus. The irritation of these nerves may be responsible for neurological symptoms in the distribution.

In cases indicating lesions of the lumbar transverse processes, the most constant finding and one of much significance is, "the location of a definite highest point of tenderness to deep pressure on the tip of one of the transverse processes. In a number of cases, the patient volunteered that he 'had pain down the leg' in addition to the local tenderness, when pressure was made directly over the site of the lesion."

The author presents the history of twenty cases.

The roentgen ray has been of valuable assistance in the identification of abnormalities and in certain cases of fractures. In several instances the roentgen diagnosis of fracture proved erroneous.

SHAW, WILLIAM FLETCHER. Carcinoma of the female urethra with notes of two cases treated with radium. *J. Obst. & Gynec. Brit. Emp.*, 1923, xxx, 215–129.

Carcinoma of the urethra is a rare disease, only about 100 cases having been reported up to the present time.

Total resection of urethra and partial resection giving bad results, the author had his 2 cases treated by radium. In the first case, the growth disappeared and several glands were removed and found to contain cancer cells.

In the second case, the growth was made smaller but had not disappeared.

WINTZ, H. Forecare and aftercare in roentgen-ray therapy. *Radiol.*, 1923, i, 74–81.

Generally speaking, special clinics for roentgen-ray treatment do not exist. "As a result of the rather simple therapeutic procedures from which deep therapy has developed, ambulatory treatment is still widely prevalent.

"Thus it occurs that the forecare and aftercare of patients treated by deep therapy is only rarely placed in the hands of the roentgen therapist."

Efficient deep therapy cannot be restricted to the application of a quantity of rays, but must take account of all the circumstances which concern the avoidance of injury and strengthening the body in its fight with cancer. It is the duty of the roentgen therapist to instruct the associate physician and prescribe rules for the patient.

1. *Forecare.* Certain demands are made of the attending physician and of the patient which must be executed before treatment is instituted, which are just as important as the preparation for an operation. These depend on the nature of the disease and the plan of treatment.

When a patient is to be treated the physician is told of the method and probable duration of such treatment. If the patient is transferred to the roentgen-ray treatment clinic, further management by the attending physician becomes unnecessary. However, if the case is sent in by the house physician only for irradiation and leaves the clinic immediately after the treatment, instructions must be given the attending physician. These comprise verification of the diagnosis, and actual preparation for irradiation. All specimens should come to the laboratory of the roentgen-ray clinic.

A complete physical examination should be made with an exhaustive anamnesis, including the condition of the skin in the rayed area, the heart and the blood picture.

In raying mammary cancer, a thorough examination of the lungs is of prime importance.

With a leucocyte count under 2,500, in conjunction with a lymphopenia and a hemoglobin index below 40 or 35 per cent, a cancer treatment should under no circumstances be given.

Iodine applications and mercury treatment make the skin intolerant to the roentgen ray. Basedow's disease shows an excessive sensitiveness of the skin, in which it is increased about 25 per cent, also certain types of diabetes and some forms of kidney disease.

When intestinal disturbances are present we prefer to wait a few days rather than irradiate the patient in such a condition.

2. *Aftercare.* There are four great factors resulting from irradiation to be met:

(1) Care of injuries ensuing upon roentgen therapy, which may be classified as general and local.

(2) Elimination of degeneration products resulting from disintegration of tumor cells, and neutralization of toxic metabolic products in normal cells.

(3) Support of the body to secure an enduring resistance against cancerous disease.

(4) Replacement by healthy tissue at the site of the cancer.

Irradiation injuries may be classified in two groups, local and general. Among the general, blood changes play an important rôle.

The gravity of local tissue injury depends on the amount of radiation used and the condition of the tissue. Special attention must be paid to the possibility of combination injury, which is one that only appears when the irradiated tissue is acted upon by some additional agent. There is a specific result of the roentgen-rays, a *locus minoris resistentiae*, produced in the rayed tissues. This occurs even with 50 or 60 per cent of the erythema dose, in which no tissue change is found. But if such a tissue is acted upon by a second irritant, changes appear out of proportion to the amount of the second agent.

The degree of lowered resistance is increased as the dose approaches the limit of tolerance. For this reason we forbid the use of hot water bottles, electric pads, radiated heat, and sunlight after roentgen-ray treatment, and we also forbid application of an ice bag. Moderate heat under some circumstances is tolerated, but even baths at a temperature of 38 or 39° C. may be irritative. We also forbid the use of all chemical salves or rubs (iodine, vasogen), or washing with benzine, benzol or terpentinol. All forms of pressure, such as that from collar bands, coat collar, and garters on the irradiated area must be avoided. Likewise chafing from clothing or rubbing corset steels, pulling or scratching the irradiated area.

The induction of a *locus minoris resistentiae* holds true for every type of tissue.

Irritations of the bladder and altered chemical composition of the urine may give rise to combination injuries. Concretions in the bladder cause unpleasant results.

There is always a possibility of combination injuries to the rectum, especially when the fecal matter passing through the irritated areas is very hard. Therefore, the condition of the bowels is to be watched very closely.

Among the local irritations which offer the possibility of combination injury are those of the oral and pharyngeal mucosa. For a few days after irradiation of cancer of the larynx there is always the possibility of edema of the glottis. In the tongue there is a chance of combination injury by food. Neither very hot nor very cold food should be taken.

Induration of rayed tissue almost always occurs if a certain area is irradiated two or three times, even at long intervals, with a dose which approaches the toleration point (90 to 100 per cent of the erythema dose). Any rough handling of this edematous induration must be avoided.

Induration of the lung, which frequently follows systematic irradiation of mammary cancer, must also be considered. While in general it is harmless, and under no circumstances requires active after-treatment, it is of importance to recognize, especially if inflammatory processes occur (bronchitis, pneumonia), which run a more severe course than in sound lungs. The only medicament of value is camphor. This lowered resistance of the lungs is often dangerous in attacks of influenza.

General damage which follows every irradiation results from the biochemical action of the roentgen rays, and in some tumors, from the liberation of degeneration products from the cells acted upon by the rays. The basis of so-called roentgen sickness is in these intoxications. Irradiation of the abdominal organs is usually followed by marked sickness. The presence of nitrous acid and, above all, ozone and its compounds, tends to increase this trouble.

It is of importance that the bowels be thoroughly cleansed out for some days preceding the irradiation, so that they will be empty during treatment.

The effects are often very severe if the patient undertakes a railway journey after intensive treatment.

Blood changes hold a special place among the general effects. They stand in direct relation to the amount of radiation received by the body. For blood injury, on the other hand, the amount of radiation absorbed by the entire body

must be taken into account. In order, therefore, to establish a comparison between roentgen-ray intensity and the amount of blood injury, we have taken a volume-dose as a unit. This unit, designated "A," corresponds to the amount of radiation received at 180 kv. with a 0.5 mm. zinc filter, at 23 cm. focal distance, in a pyramid of tissue with a base of 6 by 8 cm. and a height of 15 cm. With this the skin will receive an erythema dose. With 2½ or 3 A the first blood changes appear, which, however, quickly vanish.

With an amount of irradiation such as is used in uterine cancer, there is a lowering of the hemoglobin, and marked decrease in the number of leucocytes, especially lymphocytes. Coagulation time is affected. With high intensity, it is shortened; with less intensity and if the dose is divided by about ten-hour intervals, coagulation time is lengthened. About six weeks are required to restore the original blood picture.

Since 1914 we have not seen a single case in which a patient died as a result of acute blood destruction. The blood should be watched closely; it gives the best indication of the progress of the case. Blood transfusion sometimes betters the general condition.

The problem of raising general body resistance can be solved only by close cooperation between the house physician and the clinic. General dietetic management is also necessary.

A satisfactory result in cancer treatment does not depend alone on proper and thorough *irradiation*. A well-conducted aftercare decides the result, and even apparently simple cases present new problems which must be taken seriously, for their final solution requires much experience.

Scholtz, Moses. Precancerous skin lesions. *Calif. State J. M.*, Aug., 1923, xxi, 334–336.

A thorough familiarity with the clinical characteristics of precancerous lesions is imperative in the prevention of cancer. The tendency of a lesion to become cancerous is brought about by three factors: (1) old age; (2) damaged or changed structure of the tissue; (3) chronic mechanical, chemical, or biochemical irritations. The continued presence of these three factors is usually sufficient to stimulate a precancerous lesion into malignancy.

Senile keratoses are the most frequent sources of malignant degeneration. Richard Sutton divides this group into three parts: first, seborrheic keratosis developing from seborrheic patches; second, nevoid keratosis, springing from nevi; third, strictly keratotic type, starting from the horny layer of the epidermis.

The roentgen ray can clear up all of the senile keratoses. Radium shows all the advantages and limitations of roentgen ray. Like the roentgen ray it should be applied to selected cases.

Leucoplakia, arsenical keratoses and scars also serve as precancerous beginnings.

Aikins, W. H. B. Some results of radium treatment in sarcoma. *Canad. M. Assn. J.*, Sept., 1923, xiii, 654–656.

A myeloid sarcoma of the tibia formed a secondary deposit in the groin. After microscopic diagnosis it was submitted to heavy radiations. Ten days later tissue removed for examination showed the large cells of the growth had changed into connective tissue cells and spindle cells. The cells showed necrosis and necrobiosis. The connective tissue cells had been mobilized and the leucocytic infiltration was most intense.

Dominici says of this change following radium treatment of a vascular myeloid sarcoma that the malignant cells are destroyed by the rays and replaced by fibrous tissue, but that the sarcoma cells themselves are converted into cells indistinguishable from normal connective tissue. The lumen of the blood-vessels became smaller, so that they appeared like capillaries lying in the fibrous tissue.

When treating these conditions, avoid breaking the skin because of the dangers of infection. For deep seated growths, he uses the *gamma* rays of radium, employing flat, heavy screened applicators, the dose varying with the extent and location of the lesion.

In superficial sarcoma the *beta* rays are more satisfactory. Tubes and applicators are superior to needles in such cases.

Results in lymphosarcoma are not encouraging. In lymphogranuloma the response to radium is good, with certain striking exceptions. Osteosarcomas do not respond well to radium.

Epulis and myeloid sarcoma of bone are most suitable for treatment by radium. In melanotic sarcoma the prognosis is not so good, as metastasis is practically inevitable. In angiosarcoma the effect of radium is most satisfactory. Sarcoma of the conjunctiva responds most remarkably.

Heiman, Henry. Exophthalmic goiter in childhood with some unusual manifestations. *Am. J. Dis. Child.*, Sept., 1923, xxvi, 216–222.

The Mayo Clinic found in these cases of exophthalmic goiter three-tenths of one per cent of children under ten years of age.

The sympathomimetic symptoms may be developed by stimulation of the thoracolumbar

division of the involuntary nervous system. The ultimate cause of the disease then must act primarily or secondarily through the involuntary nervous system.

In 182 cases of exophthalmic goiter in adults, Sandiford found an average basal metabolic rate of +51 per cent.

The roentgen ray has given some favorable results. Means and Holmes in 44 recent cases of exophthalmic goiter treated with roentgen ray, report 28 patients improved. Of these 12 were apparently cured, 16 improved, but not entirely well. In no instance was a case made worse. In the favorable cases there was a rapid fall in the pulse rate (from an average of 115 to 89) and basal metabolism (from an average of +55 to +21 per cent).

Radium emanations have been used by Terry in exophthalmic goiter, mainly in preparation for thyroidectomy. Of 16 patients, 2 were cured by radium alone; 10 were well after resection of thyroid and 4 died after operation.

PEMBERTON, JOHN DEJ. The end results of surgery of the thyroid gland. *Arch. Surg.*, July, 1923, vii, 37–46.

In 1922 in the Mayo Clinic 1,983 operations were performed on 1,497 patients with goiter with mortality from operation of 0.95 per cent, and by case of 1.2 per cent.

Classification of operable thyroid condition:

(1) Diffuse colloid goiter—the common physiological thyroid enlargement in adolescence, producing no symptoms beyond those of pressure. Iodine deficiency being the etiological factor.

(2) Adenoma without hyperthyroidism. In a small proportion of cases enlargements are entirely concealed in the thoracic cavity. Operative procedure is the only effective remedy.

(3) Adenoma with hyperthyroidism. This is not to be confused with exophthalmic goiter. The symptoms of hyperthyroidism usually occur spontaneously and develop gradually but progressively. These symptoms may be induced abruptly by the administration of iodine to a patient with adenoma without hyperthyroidism. The operative mortality is between 2 and 4 per cent. Judd found after two years 83 per cent considered themselves cured and 5 per cent more were markedly improved.

(4) Exophthalmic goiter. This is characterized by an increased basal metabolic rate, by a peculiar nervous syndrome and usually by exophthalmos, with a tendency to gastric intestinal crises of vomiting and diarrhea. The cause of exophthalmic goiter is unknown but there is always the characteristic pathologic picture of diffuse parenchymatous hypertrophy and hyperplasia in the thyroid gland. Operation has particular danger just before, during, and following a crisis.

In 1922 there were 1,093 operations on 633 patients with exophthalmic goiter in the Mayo Clinic; 11 died; operative mortality of 1.005 per cent; by case, 1.74 per cent.

Wilson found in the Mayo Clinic 1 case of malignancy in 57. Recent rapid growth in the thyroid suggests malignancy. Wide surgical removal followed by radium or roentgen ray offers the best chance.

In a study of 207 cases of malignancy to January, 1921, the Mayo Clinic gave:

Sarcoma	19 cases	no cures.
Carcinoma	62 cases	5 per cent, five-year cures.
Malignant Adenoma	102 cases	20 per cent, five-year cures.
Malignant Papilloma	24 cases	33 per cent, five-year cures.

BÉCLÉRE, H. Injections of lipiodol. *Bull. et mém. Soc. radiol. méd. de France*, June, 1923, xi, 177.

The author cites 4 cases in which the presence of lipiodol in the tissues interfered with interpretation of roentgenograms. In the first case the injection had been made several years previously into the gluteal muscles and completely obscured the region of the hip joint and in the second case a similar muscular injection in the deltoid region obscured the shoulder-joint. In the third case injection in the lumbar region led to operation for calculus in the kidney. The fourth case was an injection in the back which at first glance appeared to be an advanced pulmonary lesion.

HANKS, MARY ELIZABETH. The roentgen ray in non-malignant gynecologic cases; a clinical study. *Radiol.*, Oct., 1923, i, 82–86.

Technique: 9 in. spark-gap (125,000 volts); 7 to 12 in. distance (18 to 30 cm.); 5 ma; 5 mm. of aluminum with sole leather as filters; five to seventeen minutes' time.

The cross-fire method is employed, through as many ports of entry, 3 in. in diameter, as are required to cover the disease under treatment.

The skin being rated at 100, the dose for the ovary is only 35 or less, while the other glandular tissues and also the myoma cell, are all below 100. Not only do we get with the fractional dose the reactions we seek, but we more often avoid symptoms of roentgen sickness arising from too rapid disintegration of the tissues.

The author quotes Holzknecht as follows: "Among my cases of strongly rayed myomata 5 developed hyperthyroidism, 4 hypertension, 2

distinct acromegaly and many gave clinical indications of marked ovarian irritation. Whereas, similar cases that were rayed feebly showed surprisingly excellent recovery, characterized by the absence of any untoward secondary endocrine effects."

Contraindications to roentgen treatment are as follows:

1. Pedunculated tumors are unsafe and should be operated upon.
2. Submucous tumors are unsatisfactory, provoke complications and are surgical.
3. A tumor associated with severe anemia, much tenderness and with history of fever and chilliness may be necrotic and is at once surgical.
4. A chronic tumor that suddenly grows rapidly may be undergoing some form of degeneration and is better operated upon.
5. A tumor associated with ovarian tumors (not simple follicular cysts) belongs to the surgeon.
6. A suspicion of malignancy puts the case into the hands of the short-wave expert, the radiologist or the surgeon or all of them.
7. A case associated with acute gonorrheal infection, with salpingitis or pyosalpinx, is not benefited by the roentgen ray.
8. A large non-vascular tumor, made up mainly of connective tissue, that does not bleed, is unfavorable for excellent results with roentgen ray though these cases may yield good results as to health and comfort.
9. A woman who desires children and whose subserous tumors can be enucleated, is a good subject for myomectomy.

Mohler, Henry K. Basal metabolism, the value of its estimation. *Ann. Clin. Med.*, 1923, ii, 39–41.

Today the best laboratory procedure which has been developed as an aid in the recognition of thyroid disturbance is the determination of the basal metabolic rate. It is of value as a guide to the proper treatment, whether medical, surgical, roentgen-ray or radium. All investigators agree that the basal metabolic rate varies with thyroid activity. Although the pituitary and the ovary influence basal metabolism they do so to a much less degree. Pernicious anemia, leucemia, severe diabetes mellitus and cancer may increase the basal metabolism, and starvation and wasting disease may decrease it.

The interference with the thyroid gland by surgical procedure has resulted in hypothyroidism in addition to the original disease. To this group belongs the large number of cases of so-called disordered action of the heart seen in soldiers during the recent war, patients suffering from neurocirculatory asthenia, nervousness, loss of weight, incipient tuberculosis, syphilis and gastrointestinal disturbances.

It must be remembered that the basal metabolic rate will not measure the degree of impairment of the kidneys or the heart that may be associated with impaired thyroid function.

Levy, Robert L. The size of the heart in pneumonia. A teleroentgenographic study, with observation on the effect of digitalis therapy. *Arch. Int. Med.*, 1923, xxxii, 559–585.

This investigation was undertaken to obtain by roentgenographic methods the size of the heart at frequent intervals in pneumonia cases. Teleroentgenograms of the chest were made every second day, or as nearly so as the condition of the patient warranted, in 21 cases of lobar pneumonia and 8 cases of bronchopneumonia. Three normal young men, and one with fever due to acute bronchitis and pulmonary tuberculosis served as controls.

Method of taking the roentgenogram: Half second exposures were made during inspiration, in the recumbent position, at a distance of 2 meters. In order to record graphically on the plate the phase of respiration in which the exposure was made, a lead strip was secured to the plate holder with adhesive plaster to indicate the neutral position of the vertically hanging lever of a Marey tambour, the lever being tipped with a solid knob of lead. The tambour was connected by means of rubber tubing with a Politzer bag, held in position in the right axilla of the patient by a linen binder secured by fastening its tails. During respiration, the lever of the tambour swung on one side or the other of the neutral strip. The side to which the lever deviated during expiration was denoted by a letter. The pictures were obtained during inspiration in the majority of cases. To verify the anteroposterior alignment, a thin lead strip was placed over the spinous processes of the vertebrae and two acute angles of lead were secured anteriorly, one in the suprasternal notch and the other in the substernal angle; in later plates the posterior strip of lead was omitted, as the spines could be plainly seen.

New technique for completing the outline of the cardiac silhouette. From the plates, the diastolic outline of the right and left borders and the midline were traced on paper. This made possible the measurements of transverse and long diameters. The angle of inclination of the heart—that is, the angle formed by the long diameter, and a line drawn to the apex at right angles with the median line—was also recorded. Instead of completing the silhouette by arbi-

trarily joining the ends of the lines defining the borders, a simple geometric construction was adopted, which rendered the procedure entirely objective. In the illustration reproduced herewith, the heavy lines *ad* and *be* represent, respectively, the right and left borders traced from the roentgenogram. With the distance *ab* as a radius with *a* as a center, an arc was drawn, and with the same radius with *b* as a center, another is drawn intersecting with the first at *C*; from *C* as a center with *ab* as a radius *a* and *b* are joined. The arc was constructed in like fashion employing *de* as the radius and *f* as a center. The area so delineated was measured by a planimeter.

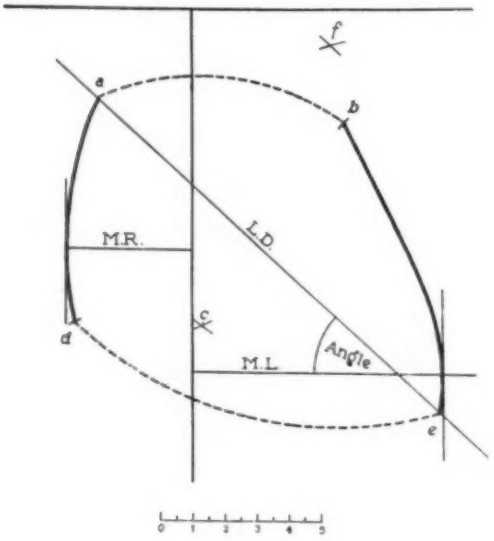

FIG. 1. Construction of the cardiac silhouette, showing area, diameters and angle.

It is evident that if the distance *ab* and *de* are constant in value, the areas bounded by these lines and their corresponding arcs must be constant in value, and variations will be accompanied by variations in area. The subjective arbitrary construction formerly employed may therefore be replaced by one which is objective, even though arbitrary, in its variations.

The control series was obtained by using normal young men, plates being taken every second or third day until six or seven had been made. Measures from these roentgenograms show that the maximum variation in transverse diameter was 0.6 cm., in the long diameter 0.4 cm. and in area 8 sq. cm.

The effect of fever and tachycardia on the size of the heart was shown by measurements of the heart in a case of acute bronchitic and pulmonary tuberculosis, but without signs of consolidation of the lungs. The maximum variation in transverse diameter was 0.7 cm., in long diameter 0.2 cm. and in area 1 sq. cm.

It seemed reasonable, on the basis of the findings, to regard as a significant change in the outline of the heart a variation of 1 cm. or more, in one of the diameters, or of 10 sq. cm. or more, in the area. Usually, when a change was observed, it took place in all measurements, and was of a greater order of magnitude than the minimal criteria established.

Results in pneumonia: The 21 cases studied presented varying degrees of severity. The usual types of organizations were present. Thirteen cases (61.9 per cent) showed an increase in the size of the heart during the illness. Digitalis was given to 10 of the cases by mouth in the form of digitan. Of the 11 not receiving digitalis, 8 (72.7 per cent) showed cardiac enlargement; of the 10 receiving the drug, 5 (50 per cent) showed cardiac enlargement.

From these facts it appears that in about 62 per cent of these cases of lobar pneumonia. cardiac dilatation occurred during the course of the disease, and that cardiac dilatation occurred less frequently in the patients who received digitalis than in those who did not.

The order of magnitude of change is of interest. In the patients not receiving digitalis, the increase in transverse diameter was from 4.5 to 15.4 per cent (average 9.3 per cent), in long diameter from 4.4 to 13.5 per cent (average 8.2 per cent), in area from 11.6 to 27.1 per cent (average 16.5 per cent). In the digitalized patients who showed enlargement, the increase in transverse diameter was from 3.6 to 19.2 per cent (average 11.0 per cent), in long diameter, from 2.6 to 19.7 per cent (an average of 10.2 per cent), in area from 11.1 to 37.3 per cent (an average of 1.5 per cent). The difference in the two groups is not striking.

The averages in the second group are increased by the figures obtained from a patient with Type III pneumococcus infection involving the entire right lung and the left lower lobe. In this man, critically ill, the transverse diameter fell from 13.6 cm. at the height of the disease to 11.4 cm. during convalescence, the long diameter from 17.0 to 14.2 cm., the area from 136 sq. cm. to 99 sq. cm.

SUMMARY

1. A teleroentgenographic study was made of 21 cases of lobar pneumonia and 8 cases of bronchopneumonia, employing a special technique in making the plates and a new method in completing the outline of the cardiac silhoutte.

2. In lobar pneumonia, cardiac dilatation occurred in 61.9 per cent of the cases. Dilata-

tion was less frequently observed in patients who received digitalis (50 per cent) than in those to whom the drug was not given (72.7 per cent).

3. In bronchopneumonia, cardiac dilatation was less frequent than in lobar pneumonia, having been observed in 25 per cent of the cases. The two patients in this group who received digitalis showed no dilatation.

4. The heart muscle in pneumonia may attempt, by lengthening its muscle fibers, to augment systolic output. Digitalis in therapeutic doses increases the contractile power of the ventricles. On the basis of these facts, early and adequate digitalis therapy is suggested in pneumonia, in the belief that the drug may exert a beneficial effect, not only in the presence of auricular fibrillation and flutter, but also when the normal rhythm prevails.

SIEVERT, ROLF M. A "radium compensator" for ionization measurements. *Acta Radiol.*, 1923, ii, 156–165.

An instrument is described for rapid observations of the intensity of β and γ rays. The apparatus is constructed primarily for medical use.

The ionization current in a small chamber is compensated by means of another similar chamber, the latter together with a sensitive electrometer being placed in a lead box. The ionization in the compensation chamber is produced by the β rays from a radium preparation, containing about 0.2 mgm. radium element. The compensation is brought about by increasing or decreasing the distance between the preparation and the last-mentioned chamber accordingly, until the electrometer thread remains in its zero position, irrespective of a switch for earthing being disconnected or not. The distance is read off on a micrometer.

Investigations of the possible error sources show that the measurement of one intensity can be made in twenty seconds without a greater error than ½–2 per cent depending upon the magnitude of the intensity.

FLEMMING-MÖLLER, P. The roentgen picture of interlobar exudates and pleural thickenings especially with regard to the differential diagnosis of tuberculous infiltrations in the upper right lobe. *Acta Radiol*, 1923, ii, 139-154.

By the roentgen examination one cannot, as most authors suppose, obtain an absolutely reliable basis for the existence of an interlobar exudate. Of course, the exudate gives quite a characteristic shadow picture, but tuberculous infiltrations in the base of the upper lobe, which is commonly seen in roentgen examination of phthisis, as well as simple bronchopneumonia may give exactly the same picture.

The roentgen examination can only lead to a supposition that it is a question of interlobar exudate, but the diagnosis can only be made in connection with the clinic and a reliable result only obtained through a positive issue of a test puncture.

A well-defined lower border of the shadow argues more in favor of an infiltration than of an exudate, whereas an upper well-defined border rather gives one to presume an exudate, as processes of infiltration are not met with so frequently in the upper part of the middle lobe. When interlobar indurations of the pleura are seen, one must absolutely direct one's attention to an eventual tuberculosis of the lungs.

SONNE, CARL. Investigations regarding the condition of the white-blood corpuscles in guinea-pigs and rabbits exposed to irradiation with visible rays. *Acta Radiol.*, 1923, ii, 116–127.

By irradiation of white, shaved guinea-pigs and rabbits with visible, luminous rays a perceptible effect on the condition of the white-blood corpuscles is proved.

In guinea-pigs an immediate decrease in the number both of lymphocytes and leucocytes occurs, but this is most pronounced for the former. Later, when the irradiation has ceased, an increase in the number of lymphocytes occurs in the course of a few days, so that this number exceeds the normal for some time. Coincidentally the number of the polynuclear leucocytes seems to be, if anything, normal.

These changes correspond to those found by Murphy and Sturm with regard to the temporary influence of dry heat on rats, mice, and guinea-pigs.

In rabbits, forty-five minutes after the irradiation, there is a very considerable increase in the number of the polynuclear leucocytes, simultaneously with a generally somewhat smaller decrease in the number of the lymphocytes, so that the normal, strongly pronounced lymphocytic form has in the course of two to three hours become leucocytic. Next day the form is again normal, so that it can once more be affected in the same manner by a new light-bath.

BAASTRUP, CHR. J. Some remarks on proc. post. tali. *Acta Radiol.*, 1923, ii, 166–175.

1. After a fract. proc. post. tali one may see fragments joined to a large and plump bone projection, which may cause the patient great inconvenience owing to the plantar flexion being diminished on account of the mechanical disproportion.

2. Such large proc. post. can also be found to be congenital.

3. Effective assistance can be rendered only by operative removal of the process.

4. With fracture of the hindmost edge of tibia one ought to inspect proc. post. tali, as this is possibly fractured at the same time, and conversely, with fracture of proc. post. tali one should remember that the hindmost edge of tibia may be broken.

WEGGE, KAI. Two unusual cases of multiple ureteral calculi. *Acta Radiol.*, 1923, ii, 264–267.

The author describes 2 cases of multiple ureteral calculi. In both cases there is a considerable number of stones, but 1 of the cases presents a very unusual picture, inasmuch as one of the ureters is closely packed with stones from the pelvis of the kidney right down to the bladder.

BAKKE, S. N. Spondylitis typhosa. *Acta Radiol.*, 1923, ii, 176–181.

The author describes a case of spondylitis typhosa, the clinical picture of which answers closely to the case described by Quincke as to the following cardinal symptoms: 1. The remarkably intense and diffuse, local pains. 2. The acute course. 3. The rapid abating of the spinal pains. 4. The noticeable swelling of the soft parts of the vertebral column. The roentgenogram is different from that seen in spondylitis tuberculosa. First of all there is no marked atrophy of lime and no destruction of the vertebral body. Parallel with the pathological process present in the body of the vertebra there is a proliferating process going on, with a bridge-like connection between the second and third vertebrae. The articular space between these two vertebrae is reduced. After fully three months a more transparent portion of the vertebrae is seen on roentgenograms in profile, a sequestrum(?) being discernible in that portion.

The process did not react to tuberculin injections.

SIEVERT, ROLF M. Secondary rays in radium therapeutics. *Acta Radiol.*, 1923, ii, 268–300.

The physical facts which seem to be of interest when studying the problem of secondary radiation in radium therapeutics are stated.

Some mathematical laws with regard to secondary radiation are fixed in order to give a general view of the distribution of this radiation.

By means of an instrument previously described in *Acta Radiologica*, investigations were made as follows:

(1) The secondary radiation from screens of different materials and thicknesses placed in various positions between a radioactive substance and the ionization chamber.

(2) The secondary radiation measured with different kinds of ionization chambers.

(3) Secondary radiation from water volumes in different positions.

. The results of the measurements in (1) seem to agree with those of other investigators.

Lastly, some questions are briefly treated which may be of interest in radium therapeutics, the following facts being emphasized:

(1) The wall of the ionization chamber should be comparatively thick (for example, 2–5 mm. ivory) when investigating the distribution of intensity.

(2) Secondary radiation is of practically no importance when emitted from tissue outside a sphere with a radius equal to the distance between the applicator and the part exposed, and with its center just between these two.

(3) When treating at a distance, the secondary filter should be placed just between the applicator and the skin, thereby giving a minimum of secondary β radiation.

Wisdom is the daughter of experience. LEONARDO DA VINCI.

Never believe what a patient tells you his doctor has said. JENNER.

For one mistake made for not knowing ten are made for not looking.